NASA

Aeronautical Engineering
A Continuing Bibliography with Indexes

NASA SP-7037(175)
June 1984

National Aeronautics and Space Administration

(NASA-SP-7037(175)) AERONAUTICAL ENGINEERING: A CONTINUING BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 175) (National Aeronautics and Space Administration) 132 p HC $6.00 CSCL 01A 00/01 N84-28726 Unclas 17783

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ACCESSION NUMBER RANGES

Accession numbers cited in this Supplement fall within the following ranges.

STAR (N-10000 Series)	N84-18153 - N84-20472
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NASA SP-7037(175)

AERONAUTICAL ENGINEERING

A CONTINUING BIBLIOGRAPHY WITH INDEXES

(Supplement 175)

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced in May 1984 in

- *Scientific and Technical Aerospace Reports (STAR)*
- *International Aerospace Abstracts (IAA).*

NASA Scientific and Technical Information Branch 1984
National Aeronautics and Space Administration
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INTRODUCTION

Under the terms of an interagency agreement with the Federal Aviation Administration this publication has been prepared by the National Aeronautics and Space Administration for the joint use of both agencies and the scientific and technical community concerned with the field of aeronautical engineering. The first issue of this bibliography was published in September 1970 and the first supplement in January 1971.

This supplement to *Aeronautical Engineering -- A Continuing Bibliography* (NASA SP-7037) lists 467 reports, journal articles, and other documents originally announced in May 1984 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA).*

The coverage includes documents on the engineering and theoretical aspects of design, construction, evaluation, testing, operation, and performance of aircraft (including aircraft engines) and associated components, equipment, and systems. It also includes research and development in aerodynamics, aeronautics, and ground support equipment for aeronautical vehicles.

Each entry in the bibliography consists of a standard bibliographic citation accompanied in most cases by an abstract. The listing of the entries is arranged by the first nine *STAR* specific categories and the remaining *STAR* major categories. This arrangement offers the user the most advantageous breakdown for individual objectives. The citations include the original accession numbers from the respective announcement journals. The *IAA* items will precede the *STAR* items within each category.

Six indexes -- subject, personal author, corporate source, contract number, report number, and accession number -- are included.

An annual cumulative index will be published.

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All publications abstracted in this bibliography are available to the public through the sources as indicated in the category sections. It is suggested that the bibliography user contact his own library or other local libraries prior to ordering any publication inasmuch as many of the documents have been widely distributed by the issuing agencies, especially NASA.

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NASA SPONSORED DOCUMENT
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N84-10017*# Kansas Univ., Lawrence. Flight Research Lab.
A LIFTING SURFACE THEORY IN ROTATIONAL FLOW Topical Report, Jun. 1981 - Dec. 1982
M. J. SHIAU and C. E. LAN Oct. 1983 74 p refs
(Contract NAG1-75)
(NASA-CR-172233; NAS 1.26:172233; CRINC-FRL-467-2) Avail: NTIS HC A04/MF A01 CSCL 01A

The partial differential equation for small disturbance steady rotational flow in three dimensions is solved through an integral equation approach. The solution is obtained by using the method of weighted residuals. Specific applications are directed to wings in nonuniform subsonic parallel streams with velocity varying in vertical and spanwise directions and to airfoils in nonuniform freestream. Comparison with limited known results indicates that the present method is reasonably accurate. Numerical results for the lifting pressure of airfoil, lift, induced drag, and pitching moments of airfoil, lift, induced drag, and pitching moments of elliptic, rectangular, and delta wings in a jet, wake, or monotonic sheared stream are presented. It is shown that, in addition to the effect of local dynamic pressures, a positive velocity gradient tends to enhance the lift. Author

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A84-10131#
EXPERIMENTAL INVESTIGATION OF CURVATURE EFFECTS ON VENTILATED WALL JETS
R. M. EL-TAHER (King Abdulaziz University, Jeddah, Saudi Arabia) AIAA Journal (ISSN 0001-1452), vol. 21, Nov. 1983, p. 1505-1511. refs

The results of an experimental study for a ventilated plane jet attaching to an offset plane surface or to an offset convex surface of circular cross section are presented. The results demonstrate the dependence of the rate of entrainment through the gap, the location of the attachment point, the growth of the length scale, and the decay of the maximum velocity on the wall curvature. Moreover, the effect of wall curvature on the mean velocity, the turbulence velocity components, and the Reynolds shear stress in the different zones of the jet are investigated. Author

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AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl. 175)

JUNE 1984

01

AERONAUTICS (GENERAL)

A84-23222* National Aeronautics and Space Administration, Washington, D. C.
AERONAUTICS FOR THE 21ST CENTURY
J. M. BEGGS (NASA, Washington, DC) High Technology (ISSN 0277-2981), vol. 4, March 1984, p. 12, 14, 17.

An assessment is made of the development possibilities of aerospace vehicle materials and structures, propulsion, avionics, configurations, computerized simulation, and operational capabilities. The supersonic transports envisioned for the 21st century would incorporate advanced, high temperature material structural design techniques, and a variable-cycle engine technology capable of a 40 percent increase in cruise efficiency over current systems, combined with low takeoff noise and efficient subsonic operation. This technology, as well as that of tilt-rotor VTOL aircraft which will be able to cruise at speeds comparable to those of present fixed-wing aircraft, are directly applicable to military systems. The impact of microelectronics and computer technologies on both avionics and the computational simulation of three-dimensional aerodynamic characteristics are also noted as important prospective developments. O.C.

A84-23250
THE IMPACT OF INCREASING COMPUTER POWER ON RAPIER SYSTEM DESIGN
H. R. SIMPSON (British Aerospace PLC, Systems Control Dept., Stevenage, Herts., England) and T. STRAKER Aerospace Dynamics (ISSN 0263-2012), Oct. 1983, p. 24-30.

A brief description is given of the basic Rapier system, its historical background, and its operational use. Three diverse areas where increased computing power has been or could be successfully introduced are examined, and the challenges and solutions arising from a predominantly digital weapon system are explored. It is pointed out that if maximum advantage is to be obtained from computerization, there must be coordination across the full range of data processing activities that contribute to or control a project's development. This coordination can take the form of an exchange of data or of the use of an integrated system covering more than one aspect of a project. The three areas discussed in the context of increased computer power are the missile command decoder, the FSB (Field Standard B) surveillance radar, and the ERV (Electronic Repair Vehicle) controller. C.R.

A84-25178#
DOUBLE-ORDER CRITERION FOR OPTIMIZING TESTS OF MULTIBLOCK AIRCRAFT SYSTEMS [DWUSTOPNIOWE KRYTERIUM OPTYMALIZACJI TESTOW DLA WIELOBLOKOWYCH SYSTEMOW LOTNICZYCH]
W. WOJCIK Instytut Lotnictwa, Prace (ISSN 0509-6669), no. 94, 1983, p. 51-57. In Polish. refs

An algorithm for designing fault-diagnostic tests to be performed during static ground tests of newly built multiblock aircraft systems is proposed; the failure detecting range is to reach the block level. Two optimization criteria are used in the algorithm: the minimum entropy of the system (the first-order criterion) and the minimum number of tests (the second-order criterion). B.J.

A84-25783
THE ASSESSMENT OF LOW LEVEL AIR DEFENCE WEAPON EFFECTIVENESS
T. MIDDLEDITCH (British Aerospace PLC, Weybridge, Surrey, England) Aerospace Dynamics (ISSN 0263-2012), Jan. 1984, p. 5-11.

The principal influences on weapon system operational effectiveness are the nature of the threat, weapon system characteristics, and weapon system deployment. Attention is presently given to low level air defense, in which the threat will be characterizable in terms of the type and number of attacking aircraft, as well as their mission profile. Deployment of defenses will depend on the number of fire units employed, their relative positions, and the character of the terrain-screening which will result from the siting used. In order to optimize the deployment of fire units, it is necessary to ensure that they cover all possible attack paths, allowing an exercise of weapon capabilities sufficient to destroy attacking aircraft before they can accomplish weapons release. Attention is given to the additional factors of a possible saturation of defenses by the attackers, meteorological complications, and computer simulations of these interacting factors. O.C.

A84-25803
THE STRUCTURED WORLD OF THE SOVIET DESIGNER
R. D. WARD (General Dynamics Corp., Fort Worth, TX) Air Force Magazine (ISSN 0730-6784), vol. 67, March 1984, p. 96-100.

A comprehensive assessment is made of the military aircraft configuration development practices of the Soviet Union, whose highly centralized governmental system has led to the distinct division of the many disciplines involved in aircraft design, development, and production among several organizations. Once the need for a new aircraft is established by the Ministry of Defense, its mission requirements are forwarded to the appropriate Air Force research institutes for conceptualization. The concepts are then configured in a preproject stage by one or more of the Prototype Design Bureaus of the Central Design Office, whose prototype designs, if approved, proceed to the building and testing stage. After the prototype has been tested and refined, it enters state acceptance trials in which it is evaluated by a Scientific and Technical Commission. If it successfully passes this stage, the design is prepared for production at one of the Ministry of Aviation's factories. To minimize disruptions in this highly bureaucratic process, individual or group initiative is restricted to specialized research, design and construction functions. Designers are judged only on the innovative manner in which they apply approved technology through the lowest risk-incurring methods. Attention is given to the emphasis generated by these constraints on design feature heredity, component commonality, and configuration economy, for the cases of the MiG design bureau's fighters, the Tupolev design bureau's subsonic and supersonic bombers, and the Sukhoi design bureau's fighter-bombers and all-weather interceptors. O.C.

N84-18153*# National Aeronautics and Space Administration, Washington, D. C.
THE CONCORDE AND AERONAUTICAL RESEARCH
M. SALMON Aug. 1983 35 p refs Transl. into ENGLISH from L'Aeron. et L'Astronautique (France), no. 11, 1969 p 7-20 Original language document was announced as A69-33380 Transl. by Kanner (Leo) Associates, Redwood City, Calif.
(Contract NASW-3541)
(NASA-TM-76973; NAS 1.15:76973) Avail: NTIS HC A03/MF A01 CSCL 01B

Theoretical and experimental work carried out in various research centers, and particularly at ONERA, which led to the conception and to the main technical solutions included in the design of Concorde: plane form, twist and camber of the wing, lift augmentation by upper surface vortices, kinetic heating, air intakes and jet exhausts, materials, aeroelasticity. The development of research, and the numerous tests carried out for the benefit of the designers since the beginning of the project, are also outlined. Author

N84-18154*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AIRFRAME TECHNOLOGY FOR AIRCRAFT ENERGY EFFICIENCY
R. L. JAMES, JR. and D. V. MADDALON Mar. 1984 26 p refs
(NASA-TM-85749; NAS 1.15:85749) Avail: NTIS HC A03/MF A01 CSCL 01B

The economic factors that resulted in the implementation of the aircraft energy efficiency program (ACEE) are reviewed and airframe technology elements including content, progress, applications, and future direction are discussed. The program includes the development of laminar flow systems, advanced aerodynamics, active controls, and composite structures. A.R.H.

N84-18156# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Systems and Logistics.
PREVENTIVE MAINTENANCE INTERVALS FOR COMPONENTS OF THE F-15/F100 AIRCRAFT ENGINE M.S. Thesis
J. R. BRILL Sep. 1983 144 p
(AD-A135637; AFIT-LSSR-93-83) Avail: NTIS HC A07/MF A01 CSCL 21E

Costs of maintenance can be reduced for many engine components by replacement before failure. This has been one objective of the Air Force Reliability Centered Maintenance (RCM) program. The key to realizing cost savings is optimization of the replacement or inspection interval. Graphic solution techniques show promise as a simple, consistent, and valid method of interval determination. They are based on use of actual age-at-failure data and cost data for individual parts of an engine, such as fuel pump of rotor disc. This study illustrates a graphic method of determining their replacement intervals, using five components of the F100/F-15 aircraft engine as a case study. The resultant optimum intervals and expected costs differ up to 50% from methods where actual costs and actual ages at failure are not used. Graphic analysis is a quick method responsive to system changes, but depends on use of representative age at failure data. This study verifies a basic technique. Existing methods can be used to aggregate the set of intervals into an engine maintenance plan. Author (GRA)

N84-18157# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PROBING INTO THE SECRET OF THE CHINESE AIR FORCE
30 Nov. 1983 114 p Transl. into ENGLISH of Enclosure to IR-6-842-0088-83 booklet: Inside the Plaaf (China) p 1-44
(AD-A135960; FTD-ID(RS)T-1089-83) Avail: NTIS HC A06/MF A01 CSCL 15C

An assessment of China's aircraft industry is given. The effectiveness of China's airforce is discussed. Several of China's fighter aircraft are discussed. R.J.F.

N84-18158# Management Consulting and Research, Inc., Falls Church, Va.
US MILITARY AIRCRAFT COST HANDBOOK Final Technical Report
W. E. DEPUY, JR., R. MOYER, P. R. PALMER, JR., B. J. MCKINNEY, G. R. KREISEL, S. J. BALUT, and G. R. MCNICHOLS 1 Mar. 1983 507 p Prepared for The Analytic Sciences Corp.
(Contract MDA903-78-C-0294)
(AD-A136035; TASC-TR-8203-1) Avail: NTIS HC A22/MF A01 CSCL 01C

Management Consulting & Research, Inc. (MCR) collected data on the Total Obligational Authority (TOA) requested by the Army, Navy and Air Force to procure attack, bomber and fighter, fixed and rotary wing aircraft. The TOA was normalized to base fiscal year 1981 dollars. Lot average, cumulate average and unit costs were calculated for Airframe, Airframe and Engine on total flyaway cost where available. Data is presented for 128 Mission/Design/Series (MDS) aircraft. Author (GRA)

N84-19279*# National Aeronautics and Space Administration, Washington, D. C.
AERONAUTICAL ENGINEERING, A CONTINUING BIBLIOGRAPHY WITH INDEXES
Feb. 1984 148 p
(NASA-SP-7037(171); NAS 1.21:7037(171)) Avail: NTIS HC $5.00 CSCL 01A

This bibliography lists 567 reports, articles and other documents introduced into the NASA scientific and technical information system in January 1984. M.A.C.

N84-19280# Naval Postgraduate School, Monterey, Calif.
A MULTI-PERIOD REPAIR PARTS INVENTORY MODEL FOR A NAVAL AIR REWORK FACILITY M.S. Thesis
A. S. ASSELIN Sep. 1983 71 p
(AD-A136873) Avail: NTIS HC A04/MF A01 CSCL 15E

A ready supply store (RSS) containing repair parts which are anticipated to be used during the production process has been established to support the naval air rework facility (NARF). While this supporting inventory was previously constructed using historical demand data, a single period model and a two-period model have been proposed which compute stock levels based on quarterly production schedules. This thesis extends the use of the projected production information in calculating RSS inventory levels from two periods to multiple periods. The disadvantage of the single period model is that it ignores information about future schedules. The multiperiod model uses the information on future schedules to behave more optimally. The multi-period model shows significant differences in inventory levels over the single-period model as a result of the added information. The multi-period model is also easily programmed on a computer and is preferred over the single-period model. GRA

02

AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

A84-23351#
TURBULENT FLOW OVER VEHICLES AT ANGLE OF ATTACK
W. S. HELLIWELL, I. E. ALBER, R. P. DICKINSON, and S. C. LUBARD (Arete Associates, Encino, CA) AIAA Journal (ISSN 0001-1452), vol. 22, March 1984, p. 321, 322; Abridged.

Previously cited in issue 06, p. 795, Accession no. A82-17740

A84-23352*# Technion - Israel Inst. of Tech., Haifa.
LATERAL AERODYNAMICS OF DELTA WINGS WITH LEADING-EDGE SEPARATION
J. KATZ (Technion - Israel Institute of Technology, Haifa, Israel) AIAA Journal (ISSN 0001-1452), vol. 22, March 1984, p. 323-328. refs
(Contract NAGW-00218)
Previously cited in issue 19, p. 2972, Accession no. A82-39142

A84-23353*# Old Dominion Univ., Norfolk, Va.
A NONLINEAR HYBRID VORTEX METHOD FOR WINGS AT LARGE ANGLE OF ATTACK
O. A. KANDIL, T. TUREAUD, and L.-C. CHU (Old Dominion University, Norfolk, VA) AIAA Journal (ISSN 0001-1452), vol. 22, March 1984, p. 329-336. refs
(Contract NSG-1560; N62269-80-C-0704)
Previously cited in issue 08, p. 1181, Accession no. A82-22094

A84-23357#
INVESTIGATION OF THE CONICAL FLOWFIELD AROUND EXTERNAL AXIAL CORNERS
W. J. BANNINK (Delft, Technische Hogeschool, Delft, Netherlands) AIAA Journal (ISSN 0001-1452), vol. 22, March 1984, p. 354-360. refs
An experimental investigation has been made of the supersonic flowfield around symmetric and asymmetric external axial corners formed by the juncture of two wedges. The measurements were performed at a Mach number of 2.95 in a 15-cm x 15-cm blow-down wind tunnel at a Reynolds number of 4 x 10 to the 5th per cm. A five-hole conical-head probe that measures pitot pressure and flow angularity was used to explore the flowfield; also, surface oil-flow pictures were taken. The main purpose of the experiments was to provide an answer to questions about the nature of the conical stagnation points. In the symmetric case, three conical stagnation points were detected: a saddle point at the corner, flanked by a node on each wedge surface. In the asymmetric configuration, the flow was found to spill over the corner toward the lower pressure side, forming a separated region. Depending on the degree of asymmetry, the separated region contained one or more vortices. It is suggested that a nodal conical stagnation point occurs on the lower pressure surface beyond the separated region.
Author

A84-23359*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
EFFECT OF BOUNDARY LAYERS ON SOLID WALLS IN THREE-DIMENSIONAL SUBSONIC WIND TUNNELS
J. B. ADCOCK and R. W. BARNWELL (NASA, Langley Research Center, Hampton, VA) AIAA Journal (ISSN 0001-1452), vol. 22, March 1984, p. 365-371. refs
Previously cited in issue 05, p. 580, Accession no. A83-16553

A84-23361#
INVESTIGATION OF MIXING IN A TURBOFAN EXHAUST DUCT. I ANALYSIS AND COMPUTATIONAL PROCEDURE
J. P. KRESKOVSKY, W. R. BRILEY, and H. MCDONALD (Scientific Research Associates, Inc., Glastonbury, CT) AIAA Journal (ISSN 0001-1452), vol. 22, March 1984, p. 374-382. refs
An analysis and computational procedure are described for computing three-dimensional, turbulent, subsonic flow in turbofan lobe mixer exhaust nozzles. The analysis is designed to treat the large secondary flows that are believed to occur within mixing ducts and to affect mixer performance. The solution procedure is first tested for a two-dimensional (axisymmetric) coaxial jet flow measured by Forstall and Shapiro. Very good agreement is obtained for both centerline velocity decay and jet spreading rate. The ability of the present procedure to obtain predictions for thrust gains and total pressure losses as a result of the mixing process is then demonstrated for a lobe mixer geometry. Flow both with and without inlet secondary vorticity is considered in calculations performed in collaboration with Povinelli and Anderson, and it is found that secondary flow associated with inlet vorticity exerts a significant influence on the mixing process. Author

A84-23365*# Northwestern Univ., Evanston, Ill.
A NONLINEAR STRUCTURAL CONCEPT FOR DRAG-REDUCING COMPLIANT WALLS
E. L. REISS (Northwestern University, Evanston, IL) AIAA Journal (ISSN 0001-1452), vol. 22, March 1984, p. 399-402; Abridged. refs
(Contract NAS1-14717)
Two mechanisms of drag reduction for flow over flat plates were investigated. The first mechanism employs Bushnell's hypothesis that compliant walls produce drag reduction by interfering with the formation of the turbulent spots in a turbulent boundary layer. It is shown that the amplitudes and frequencies of compliant wall motions for drag reduction might be achieved by using slightly curved walls and the resulting large amplitude motions of snap buckling. A simple structural model of an arch is used in the analysis, and an asymptotic method is developed. The required wall motions can be obtained by using materials like mylar. In addition, the delay of transition from laminar to turbulent flow by driven walls was studied for Poiseuille channel flow. The walls are driven by a periodic traveling wave. A significant increase in the transitional Reynolds number is obtained by appropriately prescribing the wavelength and phase velocity of the wall motion. Previously developed asymptotic methods are used in the analysis. Previously announced in STAR as N83-11061 Author

A84-23745
INJECTION OF A TRANSVERSE SONIC JET INTO A SUPERSONIC STREAM [VDUVANNIA POPERECHNOGO ZVUKOVOGO STRUMENIA U NADZVUKOVII POTIK]
V. V. KRAVETS and O. A. PRIKHODKO (Dnipropetrovs'kii Derzhavnii Universitet, Dnepropetrovsk, Ukrainian SSR) Akademiia Nauk Ukrains'koi RSR, Dopovidi, Seriia A Fiziko-Matematichni ta Tekhnichni Nauki (ISSN 0002-3531), Nov. 1983, p. 43-46. In Ukrainian. refs
The results of a numerical solution to the Navier-Stokes equations are used together with an algebraic model of turbulent viscosity to determine the gasdynamic characteristics and the interference structure of the interaction between a transverse sonic jet and a supersonic stream. Computations are carried out using the Beam-Warming implicit difference scheme and the McCormack predictor-corrector method. Computational results are compared with experimental data. V.L.

A84-23903#
NUMERICAL SOLUTION OF HYPERSONIC FLOW NEAR LEADING EDGE OF FLAT PLATE
D. FU (Beijing Institute of Aerodynamics, Beijing, People's Republic of China) Acta Aeronautica et Astronautica Sinica, vol. 4, Sept. 1983, p. 1-8. In Chinese, with abstract in English. refs
A one-step difference scheme for solving two-dimensional steady state Navier-Stokes equations is proposed to handle supersonic and hypersonic viscous interaction problems near the leading edge of a flat plate. The scheme is considered and analyzed with a model equation. It has second-order accuracy in space for steady state problems and its stability condition is improved. The scheme is much simpler, compared to the commonly used two-step predictor-corrector difference scheme for N-S equations and also is convenient for programming. Two viscous interaction problems are solved with the proposed scheme; the solutions are valid throughout the boundary layer, shock-wave structure, and inviscid core. The results show good agreement with experimental data. The numerical solutions show that the nonslip conditions can be used for weak viscous interaction. C.D.

A84-23904#

A NEW METHOD FOR CALCULATING SUPERSONIC UNSTEADY AERODYNAMIC FORCES AND ITS APPLICATION

X. WANG (Chinese Aerodynamic Research and Development Center, People's Republic of China) Acta Aeronautica et Astronautica Sinica, vol. 4, Sept. 1983, p. 9-18. In Chinese, with abstract in English. refs

A new method is proposed for calculating supersonic unsteady aerodynamic forces which combines the piston theory for unsteady flow with the conical flow theory for steady flow. Its essential feature is that the interaction of points on a wing, neglected in the piston theory, is approximated by conical flow theory. The method has been applied to flutter calculations for 29 cases of wings with 10 different types of planforms. The results are compared to flutter test data obtained in wind tunnels, and the agreement is satisfactory. The accuracy of the improved analysis is much higher than that obtained with piston theory. The method is feasible and reliable for supersonic flutter analysis and provides the advantages of briefer algorithms, higher numerical accuracy, less computing time, and easier programming. C.D.

A84-23908#

EFFECT OF A SHEAR LAYER ON STABILITY OF AN AXISYMMETRIC EXTERNAL COMPRESSION AIR INTAKE

K. ZHANG, S. YU, and C. PENG (Nanjing Aeronautical Institute, Nanjing, People's Republic of China) Acta Aeronautica et Astronautica Sinica, vol. 4, Sept. 1983, p. 56-62. In Chinese, with abstract in English.

The influence of shear layers of various strengths on the stability of an axisymmetric compression supersonic air intake is studied. Strength is defined as the ratio of total pressure difference between the two sides of a shear layer to the total pressure of the incoming flow. Six central bodies with different cone angles were used to produce shear layers with strengths ranging from 5 to 11 percent of the total pressure of upstream flow inside a free stream wind tunnel with a fixed Mach number of 1.72. Shear layers with less than 10 percent strength were strong enough to cause separation of the boundary layer from the inside surface of the cowl. Shear layers of strength less than 11 percent failed to induce buzz in the axisymmetric intake. The influence of a shear layer depended on its distance from the lip of the cowl, and was most noticeable at a distance of 10-18 percent of the cowl radius. C.D.

A84-23967

A STUDY OF SUPERSONIC AERODYNAMICS OF AIRCRAFT WITH THE AID OF THE COMPUTER [ISSLEDOVANIE SVERKHZVUKOVOI AERODINAMIKI SAMOLETOV NA EVM]

S. M. BELOTSERKOVSKII, N. A. KUDRIAVTSEVA, S. A. POPYTALOV, and V. G. TABACHNIKOV Moscow, Izdatel'stvo Nauka, 1983, 336 p. In Russian. refs

This book is concerned with a general theory regarding the characteristics of aerodynamics for aircraft at supersonic speeds, taking into account a method for the numerical determination of these characteristics and a comparison of theoretical and experimental data. General information is presented, taking into account coordinate systems, the structure of an aircraft and its geometrical parameters, kinematic parameters, boundary conditions, aerodynamic coefficients, and various functional relations. The supersonic linear steady and unsteady theory of nonsupporting surfaces is considered in a form which is suited for an extensive utilization of computer calculations. All necessary information is provided at a level which is convenient for programming and for applications related to studies involving aerodynamics, aeroelasticity, and flight dynamics. G.R.

A84-24101#

PAN AIR APPLICATIONS TO AERO-PROPULSION INTEGRATION

A. W. CHEN and E. N. TINOCO (Boeing Commercial Airplane Co., Seattle, WA) Journal of Aircraft (ISSN 0021-8669), vol. 21, March 1984, p. 161-167. refs

Previously cited in issue 16, p. 2295, Accession no. A83-36364

A84-24102#

A METHOD FOR PREDICTING LOW-SPEED AERODYNAMIC CHARACTERISTICS OF TRANSPORT AIRCRAFT

L. E. MURILLO and J. H. MCMASTERS (Boeing Commercial Airplane Co., Seattle, WA) Journal of Aircraft (ISSN 0021-8669), vol. 21, March 1984, p. 168-174.

Previously cited in issue 17, p. 2456, Accession no. A83-38673

A84-24108*# Old Dominion Univ., Norfolk, Va.

POTENTIAL FLOW PAST AXISYMMETRIC BODIES AT ANGLE OF ATTACK

J. M. KUHLMAN and J.-Y. SHU (Old Dominion University, Norfolk, VA) Journal of Aircraft (ISSN 0021-8669), vol. 21, March 1984, p. 218-220. refs

(Contract NSG-1357)

The Karamcheti (1966) suggestion concerning the use of higher order singularity techniques has been developed for the calculation of incompressible flow past an axisymmetric body at angle of attack. Attention is given to the results of a convergence study using this axial singularity method, where solution accuracy has been investigated for ellipsoids of slenderness ratio in the 1-10 range for both axial and inclined flow. Effects of singularity type, element number and size distribution, and singularity line inset distance, are noted, and a paneling scheme is developed which yields accurate results for the class of axisymmetric bodies having continuous body slopes with discontinuous curvature jumps. O.C.

A84-24109#

MODIFYING TRANDES TO OBTAIN GIVEN LIFT COEFFICIENT

G. F. HALL (Texas A&M University, College Station, TX) Journal of Aircraft (ISSN 0021-8669), vol. 21, March 1984, p. 220, 221.

The transonic airfoil analysis and design program TRANDES has undergone alterations which allow it to achieve convergence to lift coefficient. These changes have been verified through the investigation of a NACA 0012 airfoil section at both subcritical and supercritical Mach numbers, with (1) no boundary layer, (2) the default boundary layer of Carlson (1977), and (3) a laminar/turbulent boundary layer with natural transition. The results obtained are consistent with the standard angle-of-attack input procedure. O.C.

A84-24191*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

FLOW IMPROVEMENTS IN THE NASA LANGLEY 4- BY 7-METER TUNNEL CIRCUIT

Z. T. APPLIN (NASA, Langley Research Center, Subsonic Aerodynamics Branch, Hampton, VA) IN: Aerodynamic Testing Conference, 13th, San Diego, CA, March 5-7, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 155-162. refs

(AIAA PAPER 84-0603)

The mean velocity profiles in both the horizontal and vertical planes of symmetry at specific locations throughout the tunnel circuit to identify the most promising means for improving the flow in the 4 by 7 meter wind tunnel were measured. In the base line tunnel flow surveys, the flow patterns near the end of the test section indicate a uniform mean velocity distribution. Downstream of the test section, unsymmetrical flow patterns result in low velocities along the inner walls and in flow separation along the inner wall of the diffuser upstream of the drive fan and along the outer wall of the large diffuser downstream of the drive fan. A set of trailing-edge flaps attached to the five flow-control vanes located just downstream of the first corner were installed. These flaps are successful in making the tunnel flow more symmetrical and in eliminating the regions of separation in the diffusers upstream and downstream of the drive fan. Previously announced in STAR as N84-15117 Author

A84-24198#
AN INVESTIGATION OF CIVIL TRANSPORT AFT BODY DRAG USING A THREE-DIMENSIONAL WAKE SURVEY METHOD
T. H. HALLSTAFF and G. W. BRUNE (Boeing Commercial Airplane Co., Seattle, WA) IN: Aerodynamic Testing Conference, 13th, San Diego, CA, March 5-7, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 224-235. refs
(AIAA PAPER 84-0614)
Measurements of the drag and wake flow field of civil transport airplane aft bodies are presented. The investigation was conducted in the Boeing Research Wind Tunnel in Seattle at low speed (M = 0.18) and a Reynolds number of 10 x 10 to the 6th based on total length of the longest body. The effects of aft body length and upsweep were studied using both force balance and three-dimensional wake survey techniques. A data reduction procedure based on the method of Betz (1925) and Maskell (1972) was developed to obtain profile and vortex drag from the measured wake flow data. Results obtained by force balance and wake survey methods agreed well. Measured drag of bodies without upsweep were in good agreement with predictions, but upsweep drag was found to be greater than estimated using an empirical method based on data from high wing transport airplanes. Author

A84-24206#
WIND-TUNNEL TESTS ON A HIGH PERFORMANCE LOW-REYNOLDS NUMBER AIRFOIL
S. M. MANGALAM (Old Dominion University, Norfolk, VA) and W. PFENNINGER (Bionetics Corp., Hampton, VA) IN: Aerodynamic Testing Conference, 13th, San Diego, CA, March 5-7, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 300-304. refs
(AIAA PAPER 84-0628)
Results of wind-tunnel tests on a recently developed low Reynolds number airfoil are presented. The tests covered a Reynolds number range of 50,000-150,000 based on airfoil chord. Experimental and theoretical aerodynamic characteristics of the airfoil are compared, and results of the application of roughness strips to induce early transition and turbulent reattachment are presented. Substantial increases in aerodynamic efficiency compared to smooth airfoil were obtained, with values close to or exceeding theoretically predicted ones in the neighborhood of Re ≈ 100,000 at a 4 degree angle of attack. Boundary layer stethoscope observations show that the turbulators drastically reduced or eliminated laminar separation bubbles on the upper surface ahead of the rear pressure rise area and enabled satisfactory reattachment at low Re. C.D.

A84-24737
NUMERICAL STUDY OF INCOMPRESSIBLE SLIGHTLY VISCOUS FLOW PAST BLUNT BODIES AND AIRFOILS
A. Y. CHEER (California, University, Berkeley, CA) SIAM Journal on Scientific and Statistical Computing (ISSN 0196-5204), vol. 4, Dec. 1983, p. 685-705. refs
(Contract W-7404-ENG-48; N00014-76-C-0316)
A grid-free numerical method is used to simulate incompressible flow at high Reynolds numbers. The numerical method simulates the flow inside the boundary layer by vortex sheets and the flow outside this layer by vortex blobs. The algorithm produces a smooth transition between the sheets and the blobs. The accuracy of this hybrid numerical method is tested in several numerical experiments. In the first experiment, the algorithm is used to simulate slightly viscous flow past a circular cylinder. In the second experiment, the algorithm is used to simulate flow past a Joukowski airfoil at various angles of attack. In the latter case, the computations simulating the flow at the airfoil's trailing edge do not 'blow-up'. In both experiments, the calculated flow and its functionals (such as lift and drag coefficients) are in good agreement with both theoretical results and wind tunnel experiments. Author

A84-24893
TRANSONIC OBLIQUE-WING FLOW COMPUTATION
T. EVANS (East Anglia, University, Norwich, England) and H. K. CHENG (Southern California, University, Los Angeles, CA) Quarterly Journal of Mechanics and Applied Mathematics (ISSN 0033-5614), vol. 37, Feb. 1984, p. 33-55. Navy-supported research. refs
A method of calculating the steady transonic flow field around a large-aspect-ratio wing inclined obliquely to the direction of motion is presented. Asymptotic analysis based on the large aspect ratio reduces the computation to that for a developing two-dimensional field as the span is traversed downstream; nonlocal influence is included via a downwash. The developing field is calculated by an ADI method similar to methods successful for low-frequency unsteady transonic flow. Core requirements are modest. Comparison is made with results from other methods of calculating three-dimensional steady transonic flows. Author

A84-24894
THE EFFECT OF A SURFACE DISCONTINUITY ON AN AXISYMMETRIC BOUNDARY LAYER
P. W. DUCK (Manchester, Victoria University, Manchester, England) Quarterly Journal of Mechanics and Applied Mathematics (ISSN 0033-5614), vol. 37, Feb. 1984, p. 57-74. refs
The effect of an axisymmetric discontinuity in surface boundary conditions on the boundary layer on a slender body of revolution is studied. Three distinct sizes of body radius are studied, corresponding to situations in which the radius is greater than, equal to, or smaller than the classical boundary-layer thickness. In all cases, the flow is found to have a three-layered (or 'triple-deck') structure, involving a nonlinear 'lower-deck' problem, which is solved numerically using a recently developed numerical method, in which the solution is obtained iteratively in Fourier-transform space. Author

A84-24896
REGULAR REFLECTION OF A WEAK SHOCK WAVE FROM A RIGID POROUS WALL
J. F. CLARKE (Cranfield Institute of Technology, Cranfield, Beds., England) Quarterly Journal of Mechanics and Applied Mathematics (ISSN 0033-5614), vol. 37, Feb. 1984, p. 87-111. Research supported by the Ministry of Defence (Procurement Executive). refs
Mean velocity and pressure within the porosities are linked by Darcy's law in modeling the transient response of a layer of porous material to pressure changes imposed at its open upper surface. It is noted that, with a polytropic relation between pressure and density, the pressure satisfies an equation of the diffusion type. Solution of the latter when pressure changes are modest yields a pressure/normal velocity relationship at the upper interface between the porous material (which is sealed at its lower surface) and the atmosphere. This makes it possible, using a nonlinear theory of weak wave behavior, to describe the flow field that results from the collision of a weak plane shock with the surface at an angle of incidence that would give rise to a regular reflection from a solid interface. The results are seen as indicating that substantial reduction in reflected shock strength can take place over distances of the order of tens of centimeters from the interface. C.R.

A84-25203

VISUALIZATION OF BOUNDARY LAYER TRANSITION ON A CONE WITH LIQUID CRYSTALS

H. SCHOELER (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Institut fuer experimentelle Stroemungsmechanik, Goettingen, West Germany) and A. BANERJI (Indian Space Research Organization, Vikram Sarabhai Space Centre, Trivandrum, India) IN: ICIASF '83; International Congress on Instrumentation in Aerospace Simulation Facilities, Saint-Louis, Haut-Rhin, France, September 20, 1983, Record . New York, Institute of Electrical and Electronics Engineers, 1983, p. 15-22. refs

Transition on 5 deg half angle cones was investigated experimentally in the Ludwieg tube wind tunnel at DFVLR Goettingen by means of the liquid crystal technique. Influence of angle of attack, nose radius, Mach number and free stream Reynolds number was studied. Small variations in angle of attack around 0 deg strongly influence transition, which is promoted on the leeward surface and delayed on the windward side. The location of the transition region is very sensitive to nose radii between 0-0.75 mm. Decrease in Mach number promotes transition. No effect of free stream Reynolds number was observed on the transition Reynolds number. Author

A84-25214#

EXPERIMENTAL MEASUREMENTS OF THE AERODYNAMIC SURFACE PRESSURES ON SPINNING BODIES

M. C. MILLER (U.S. Army, Armament, Munitions and Chemical Command, Aberdeen Proving Ground, MD) IN: ICIASF '83; International Congress on Instrumentation in Aerospace Simulation Facilities, Saint-Louis, Haut-Rhin, France, September 20, 1983, Record . New York, Institute of Electrical and Electronics Engineers, 1983, p. 117-130. refs

This paper describes a new experimental method to obtain quantitative measurements of the surface pressures on spinning wind tunnel models using an unconventional model design and instrumentation arrangement. The non-spinning inner portion of the model containing the pressure measuring apparatus detects the surface pressures through a series of vent holes located in the spinning outer portion of the model by means of a unique sliding seal mechanism. This method avoids the limitations of conventional experimental techniques and can be employed on spinning bodies at any attitude and flow regime and on bodies containing irregular external configurations. The validity and performance capabilities of the experimental method have been demonstrated by wind tunnel tests for a variety of different aerodynamic body configurations, including a spinning circular cylinder, a Magnus autorotor , and a spin stabilized projectile. The relative simplicity and versatility of the method make it applicable to a broad range of fluid dynamic investigations concerning spinning bodies. Author

A84-25225

VELOCITY CHARACTERISTICS OF THE WAKE OF AN IN-CYLINDER PROJECTILE

A. F. BICEN and J. H. WHITELAW (Imperial College of Science and Technology, London, England) IN: ICIASF '83; International Congress on Instrumentation in Aerospace Simulation Facilities, Saint-Louis, Haut-Rhin, France, September 20, 1983, Record . New York, Institute of Electrical and Electronics Engineers, 1983, p. 191-199. Army-supported research. refs

An experimental investigation of the fluid motion in the wake of an in-cylinder projectile accelerated from rest by compressed gas is reported. The test rig is described together with the experimental techniques used for projectile and fluid velocity measurements, and the experimental uncertainties. are briefly discussed. It is found that the flow at any given time in the cycle is nearly one-dimensional and laminar with velocity fluctuations corresponding to maximum intensities of about four percent. The boundary layers remain laminar during the cycle and correspond to about one percent of the cylinder diameter. The fluid velocities are linearly distributed in the space between the breech and projectile base with velocities increasing from zero at the breech to that of the projectile near the base. The fluid velocities show a linear dependence on the projectile speed obtained at different initial gas pressures. C.D.

A84-25416

THE FLOW DEVELOPMENT IN A SHIELDING JET

J. N. BAKER (Liverpool, University, Liverpool, England) Aeronautical Journal (ISSN 0001-9240), vol. 88, Jan. 1984, p. 435-443. refs

The flow from a high aspect ratio rectangular nozzle has been studied, so as to provide data to aid prediction of the effectiveness of this type of jet flow for acoustic shielding. Flow parameters investigated in both stationary and parallel, co-flowing, airstreams, include axial center-line velocity decay, jet width growth and velocity profile similarity. The existence of significant velocity peaks towards the edge of the jet in the plane of the major axis was observed, together with an unexpected interaction on this jet flow by an adjacent circular and subsonic jet. Author

A84-25425#

FINITE ELEMENT ANALYSIS OF TRANSONIC FLOW IN NOZZLES WITH SMALL THROAT-WALL RADIUS OF CURVATURE

H. SHEN, C. LIN, M. JI, and J. SUN Northwestern Polytechnical University, English Translation of Selected Papers, ET-10, Nov. 1983, p. 1-8.

An improved finite element method is applied to calculate the transonic flow field in axisymmetric nozzles with small throat-wall radius of curvature. The basic equations of aerodynamics are used directly as the governing differential equations. By means of the least squares method, the finite element equations are formulated. For each time step, calculations are 'swept' on from one element to another. Calculations begin with initial field values and march forward in time until steady state condition is reached. Computations are made for transonic flow through different axisymmetric supersonic nozzles. The numerical accuracy of the solution is confirmed by comparison with known exact solution and with experimental data. Author

A84-25565

AN EVALUATION OF THE EFFECT OF THE CIRCUMFERENTIAL INHOMOGENEITY OF THE TOTAL PRESSURE FIELD OF THE INLET FLOW ON THE PARAMETERS OF AN AXIAL-FLOW COMPRESSOR [K OTSENKE VLIIANIIA NA PARAMETRY OSEVOGO KOMPRESSORA OKRUZHNOI NERAVNOMERNOSTI POLIA POLNOGO DAVLENIIA VKHODNOGO POTOKA]

L. S. ABAIMOV and IU. I. KLIMNIUK Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 3, 1983, p. 55-57. In Russian.

Approximate analytical expressions are derived for calculating the efficiency, pressure rise, and air flow rate of an axial-flow compressor with allowance for the circumferential inhomogeneity of the inlet flow. The expressions can be used for estimating changes in the thrust and specific fuel consumption of a gas turbine engine with a circumferentially inhomogeneous inlet flow. The efficiency, pressure rise, and air flow rate are calculated for two axial-flow compressors using the expressions proposed here, and the results are found to agree with experimental data to within 1-2 percent. V.L.

A84-25576

A STUDY OF AN UNDEREXPANDED SONIC JET ISSUING FROM A SLOT ALONG A SOLID SURFACE [ISSLEDOVANIE ZVUKOVOI NEDORASSHIRENNOI STRUI, ISTEKAIUSHCHEI IZ SHCHELI VDOL' TVERDOI POVERKHNOSTI]

L. N. LEBEDEVA and V. V. FILATOV Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 3, 1983, p. 86-88. In Russian. refs

Injection through a slot along the surface of a solid body is known to be one of the methods for stabilizing flows with separation regions. In the study reported here, the structure of a wall jet is investigated experimentally, with the ratio of the integral pressure of the injected jet to the static ambient pressure varying from 2 to 14. Three types of flow are identified for pressure ratios of 2-4, 4-10, and 12 and more, respectively. V.L.

A84-25615
PULSATIONS IN THE INTERACTION OF A SUPERSONIC JET WITH A CAVITY [PUL'SATSII PRI VZAIMODEISTVII SVERKHZVUKOVOI STRUI S POLOST'IU]
A. I. KOTOV and E. A. UGRIUMOV Leningradskii Universitet, Vestnik, Matematika, Mekhanika, Astronomiia (ISSN 0024-0850), Jan. 1984, p. 64-68. In Russian. refs

Results are presented from a numerical investigation employing the Godunov method of the low-frequency pulsations seen in the interaction between a supersonic jet and a cavity. The process by which self-oscillations develop after the pulsed 'triggering' of the nozzle is examined. The way in which the magnitudes of pressure and frequency that are characteristic of the pulsations depend on the parameters of the incoming jet and the dimensions of the jet and cavity is determined. The results obtained from numerical computations are compared with experimental data in the literature. Methods are proposed for estimating the pressure during pulsations using known formulas. C.R.

A84-25617
SUPERSONIC NONSTATIONARY FLOW AROUND FLAT AND AXISYMMETRIC TAPERED BODIES [O SVERKHZVUKOVOM NESTATSIONARNOM OBTEKANII PLOSKIKH I OSESIMMETRICHNYKH ZAOSTRENNYKH TEL]
E. A. POTEKHINA Leningradskii Universitet, Vestnik, Matematika, Mekhanika, Astronomiia (ISSN 0024-0850), Jan. 1984, p. 80-84. In Russian.

The motion of flat and axisymmetric tapered bodies at varying supersonic velocities is considered. A solution is obtained in the form of a power series of the small parameter representing the time that a gas particle spends in the shock layer. It is noted that the solution obtained in elementary functions can also be used to determine flow parameters in a shock layer, at the surface of axisymmetric bodies with a channel, and at the surface of tapered shapes. The computational results obtained with the approximate analytical solution are found to agree satisfactorily with calculations made with the method of characteristics and with experimental data for a broad range of Mach numbers. C.R.

A84-25862
FINITE ELEMENT METHOD APPLIED TO SOLVING THE TRANSONIC INTEGRAL EQUATIONS OF THREE DIMENSIONAL THIN WINGS
Z.-S. YANG (Nanjing Aeronautical Institute, Nanjing, People's Republic of China) IN: Finite element flow analysis; Proceedings of the Fourth International Symposium on Finite Element Methods in Flow Problems, Tokyo, Japan, July 26-29, 1982 . Tokyo/Amsterdam, University of Tokyo Press/North-Holland Publishing Co., 1982, p. 425-432. refs

An integral-equation/finite-element technique is developed to calculate supercritical flow with embedded shock wave about a 3D thin wing with an without lift. Oswatitsch quadratic equations are reduced to first order in the supercritical region by introducing an artificial-viscosity term analogous to that used by Piers and Slooff (1979). The nonlinear integral equations are solved iteratively by combining the vortex-lattice and collocation finite-element methods. The method is applied to a rectangular wing and a constant-chord sweptback wing with a 6-percent-thick circular-arc section at angles of attack zero and 3 deg. The results are compared to those obtained with a finite-differences scheme by Bailey and Steger (1972) in graphs: good agreement with rapid convergence is obtained. T.K.

A84-25870
BLADE-TO-BLADE CALCULATION BY FINITE ELEMENT - COMPARISON OF VARIOUS APPROACHES
F. MARTELLI (Firenze, Universita, Florence, Italy) IN: Finite element flow analysis; Proceedings of the Fourth International Symposium on Finite Element Methods in Flow Problems, Tokyo, Japan, July 26-29, 1982 . Tokyo/Amsterdam, University of Tokyo Press/North-Holland Publishing Co., 1982, p. 759-766. Sponsorship: Ministero della Pubblica Istruzione. refs
(Contract MPI-10/02-1297)

Inviscid compressible steady 2D flow through cascades of blades is investigated numerically, comparing the potential-flow and stream-function approaches within the finite-element method in terms of reliability, accuracy, and computation time. The theoretical analysis of Gelder (1971) on the compressible-flow equations in the finite-difference technique is applied, and the solution codes adopt an overrelaxation method. Both approaches are used to compute blade-to-blade flows in two typical large-deviation turbine-blade cascades. The results are presented graphically along with the experimental measurements of Sieverding (1976). The problems considered have 963 nodes and require 40 sec with the potential-flow approach and 20 sec with the stream-function approach. The accuracy is good at high Mach numbers, but further refinement is needed at leading and trailing edges to improve reliability. T.K.

A84-25883
EXTENSION OF BOUNDARY ELEMENTS TO LIFTING COMPRESSIBLE AERODYNAMICS
G. F. CAREY (Texas, University, Austin, TX) IN: Finite element flow analysis; Proceedings of the Fourth International Symposium on Finite Element Methods in Flow Problems, Tokyo, Japan, July 26-29, 1982 . Tokyo/Amsterdam, University of Tokyo Press/North-Holland Publishing Co., 1982, p. 939-943. refs

It is noted that boundary element methods have been produced for several classes of problems, in particular for linear potential flows (Brebbia, 1978; Cruse and Rizzo, 1975). There have been a number of cases where these methods have been applied to porous flow problems and to similar examples from water resources (Gray et al., 1977, 1980). Finite element studies employing boundary element methods in aerodynamics have for the most part been confined to incompressible flows and nonlifting airfoils. Consideration is given here to an extension of the method to problems involving circulation. The way in which subcritical compressible flows may be solved is indicated. In treating compressible potential flows, only the nonlifting case is considered. C.R.

A84-25894
PRINCIPAL SOLUTIONS AND FINITE-ELEMENT PROCEDURES
J. C. WU (Georgia Institute of Technology, Atlanta, GA) IN: Finite element flow analysis; Proceedings of the Fourth International Symposium on Finite Element Methods in Flow Problems, Tokyo, Japan, July 26-29, 1982 . Tokyo/Amsterdam, University of Tokyo Press/North-Holland Publishing Co., 1982, p. 1063-1070. refs
(Contract N00014-75-C-0249)

An FEM procedure has been developed for the solution of flow problems which employs integral representations of flow variables obtained by means of the 'principal solution' concept of differential equations. This approach yields algebraic equations that are drastically different from the more familiar FEM and finite difference equations, and offers a series of important advantages. Attention is presently given to the role of the principal solutions in the formulation of flow problems for FEM computations, and to the results which best illustrate the essential features of this approach. O.C.

A84-25990#

THE STREAM-LINE ITERATION METHOD FOR COMPUTING THE TWO-DIMENSIONAL TRANSONIC FLOW IN ORTHOGONAL STREAM-LINE COORDINATES

Y. CHEN (Beijing Institute of Aeronautics and Astronautics, Beijing, People's Republic of China) Acta Aerodynamica Sinica, no. 4, 1983, p. 10-19. In Chinese, with abstract in English. refs

In this paper the stream-line iteration method is presented. By using this method, numerical solutions of 2-D steady inviscid gasdynamic equations in orthogonal stream-line coordinates are obtained. The basic procedure of the method is that in every iteration step, all the flow field flow velocities in every stream-line are computed line by line from the body surface out to the far boundary of the flow field, while the shape of next line is also obtained. Using the present method under conditions of zero attack-angle and transonic flow, a bicircular-arc NACA 0012 and 10 percent R. A. E 101 profile were computed. The result for the bicircular-arc profile is in good agreement with experiment data. In comparison with other methods the results for blunt nose profiles are satisfactory. Author

A84-25993#

NUMERICAL AND APPROXIMATE METHODS FOR COMPUTING STEADY INVISCID SUPERSONIC FLOW OVER NON-SYMMETRICAL BODY WITH ANGLE OF SIDE SLIP

L. ZHANG and Z. GUO (China Aerodynamic Research and Development Center, People's Republic of China) Acta Aerodynamica Sinica, no. 4, 1983, p. 40-49. In Chinese, with abstract in English.

This paper presents numerical and approximate methods for calculating the inviscid steady supersonic flow over a nonsymmetrical body (spherecones or re-entry body with control flaps). The methods are devoted to determining asymmetrical body, taking into account angle of attack, angle of side slip, and roll angle. The numerical calculation determines the flow field while the approximate calculation presents aerodynamic stability coefficients. The pressure centers of present calculations are compared with experimental results. They are in fair agreement as long as the flow is not separated. Author

A84-25994#

AN IMPROVED SECOND-ORDER SHOCK-EXPANSION METHOD

L. ZHUANG and K. ZHU (University of Science and Technology of China, Hefei, People's Republic of China) Acta Aerodynamica Sinica, no. 4, 1983, p. 50-56. In Chinese, with abstract in English. refs

Some improvements are presented on the second-order shock-expansion method for predicting the continuous pressure distribution on the surface of a pointed body of revolution in an axially symmetrical supersonic flow. A set of three first-order ordinary differential equations is formulated, and the predictive procedure is simplified to the level of the generalized shock expansion method. The accuracy of the method is better than that of the original second-order shock-expansion method. The predicted results agree quite well with those of characteristic methods and experimental measurements in the range of hypersonic similarity parameter values up to about two. C.D.

A84-26052

SUBSONIC TURBULENT FLOW OVER A REARWARD FACING SEGMENTED STEP

S. L. GAI and S. D. SHARMA (Indian Institute of Technology, Bombay, India) Physics of Fluids (ISSN 0031-9171), vol. 27, March 1984, p. 544-546. refs

Flow visualization experiments are conducted to study the phenomena of separation and reattachment behind a segmented step in subsonic turbulent flow. The results show that the effect of castellations on the step face is to produce strong three-dimensional disturbances in the initial recirculation region. This is followed by a complex reattachment process and a transition region in which the three-dimensional disturbances are attenuated, the flow eventually resembling a two-dimensional flow in the relaxation far downstream. Author

A84-26330

TRANSONIC FLOW OF AN ELASTIC MEDIUM PAST A THIN RIGID BODY [TRANSZVUKOVOE OBTEKANIE TONKOGO TVERDOGO TELA UPRUGOI SREDOI]

I. V. SIMONOV Prikladnaia Matematika i Mekhanika (ISSN 0032-8235), vol. 48, Jan.-Feb. 1984, p. 114-122. In Russian. refs

The two-dimensional problem concerning the steady motion of a rigid body in an infinite elastic medium is analyzed for the transonic velocity range. For a complex function describing the longitudinal component of the velocity and stress field, the generalized Hilbert problem is examined. The transverse component of the field is expressed in a simple way in terms of a solution to the Hilbert problem. An analysis is presented for the following two cases: (1) medium separation occurs at the rear edge of the body and (2) separation occurs at a certain (unknown) point on the body. V.L.

A84-26333

EVOLUTION OF THE DISCONTINUITY OF A VORTEX SHEET [EVOLIUTSIIA IZLOMA VIKHREVOI PELENY]

S. K. BETIAEV and I. A. SOLNTSEV Prikladnaia Matematika i Mekhanika (ISSN 0032-8235), vol. 48, Jan.-Feb. 1984, p. 145-148. In Russian. refs

An analysis is presented for the two-dimensional problem concerning the motion of a vortex sheet initially represented by two sides of an angle equal to 2pi - pi/k (where k is greater than or equal to 1/2 but less than 1). The problem is solved by using the method of boundary integro-differential equations proposed by Smith (1968). The method makes it possible to reduce the dimensionality of the problem, so that the plane self-similar problems are reduced to problems of determining a function of a single variable. V.L.

A84-26367

THE GROUND BOUNDARY-LAYER FLOW INDUCED BY AN AIRFOIL SECTION [DIE VON EINEM TRAGFLUEGELPROFIL INDUZIERTE GRENZSCHICHTSTROEMUNG AN DER BODENEBENE]

E. BEESE (Bochum, Ruhr-Universitaet, Bochum, West Germany) Zeitschrift fuer Flugwissenschaften und Weltraumforschung (ISSN 0342-068X), vol. 8, Jan.-Feb. 1984, p. 17-27. In German. refs

The present study is concerned with the case in which an airfoil section is in a state of constant motion relative to a ground plane, which is moving below the airfoil section. In the case of variations of the angle of incidence, the 'altitude' remains constant. The two-dimensional laminar, incompressible boundary-layer flow which develops along the ground plane is investigated. Similarity solutions of the boundary-layer equations are obtained for the far-field. The obtained results are universally valid for all airfoil shapes. In the case of the near-field, for which the particular shape of an individual airfoil section becomes important, a numerical procedure is used for the integration of the equations. Attention is given to results regarding the skin friction, the displacement thickness, and the separation conditions. G.R.

A84-26368

INTEGRAL EQUATIONS FOR LIFTING SURFACES IN UNSTEADY FLOW

R. VEPA (Indian Institute of Technology, Madras, India) Zeitschrift fuer Flugwissenschaften und Weltraumforschung (ISSN 0342-068X), vol. 8, Jan.-Feb. 1984, p. 27-32. refs

The present paper deals with the integral equations for unsteady aerodynamic pressures on planar and nonplanar lifting surfaces performing small time dependent arbitrary motions in subsonic, transonic and supersonic flows. These equations are derived and presented in a compact form which is new in the literature. The singularities in the associated kernel functions are shown to be similar to the singularities in the kernel functions corresponding to lifting surfaces oscillating with simple harmonic motion. Possible

solution schemes for calculating time dependent unsteady pressures are then discussed. Author

N84-18159*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AIRFOIL INTERACTION WITH IMPINGING VORTEX
K. W. MCALISTER and C. TUNG Feb. 1984 86 p refs
Prepared in cooperation with Army Aviation Systems Command, St. Louis, Mo.
(NASA-TP-2273; E-1585; NAS 1.60:2273; AVSCOM-TR-83-A-17) Avail: NTIS HC A05/MF A01 CSCL 01A

The tip of a finite-span airfoil was used to generate a streamwise vortical flow, the strength of which could be varied by changing the incidence of the airfoil. The vortex that was generated traveled downstream and interacted with a second airfoil on which measurements of lift, drag, and pitching moment were made. The flow field, including the vortex core, was visualized in order to study the structural alterations to the vortex resulting from various levels of encounter with the downstream airfoil. These observations were also used to evaluate the accuracy of a theoretical model. Author

N84-18160# Toronto Univ., Downsview (Ontario). Inst. for Aerospace Studies.
AN APPROACH TO THE DESIGN OF AIRFOILS WITH HIGH LIFT TO DRAG RATIOS
D. W. ZINGG Nov. 1983 69 p refs
(UTIAS-TN-245; ISSN-0082-5263) Avail: NTIS HC A04/MF A01

A procedure for the design of low-speed, single-element airfoils with high lift to drag ratios is presented. The procedure uses an inverse approach which proceeds from a set of desirable boundary layer characteristics, which are determined from the performance objectives, to a velocity distribution and, finally, to an airfoil shape. The boundary layer shape factor, which is a measure of the nearness of the boundary layer to separation, is used to define the boundary layer characteristics in the upper surface pressure recovery region. The turbulent boundary layer equations are solved in inverted form to calculate the velocity distribution which corresponds to a shape factor variation. The velocities on the upper surface prior to pressure recovery are chosen to cause boundary layer transition at a desired location. The lower surface velocity distribution is selected to satisfy the requirement that a closed, non-reentrant shape which meets the specified structural requirements results. The design procedure described can be utilized for the design of high performance airfoils for a variety of performance objectives, operating conditions, and practical constraints. Using this procedure, an airfoil was designed which achieves a lift to drag ratio of 180 at a lift coefficient of 1.2 and a Reynolds number of one million. Through this design study, a set of guidelines for the design of airfoils with high lift to drag ratios is established. Author

N84-18161*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AERODYNAMIC DESIGN FOR IMPROVED MANUEVERABILITY BY USE OF THREE-DIMENSIONAL TRANSONIC THEORY
M. J. MANN, R. L. CAMPBELL, and J. C. FERRIS Feb. 1984 72 p refs
(NASA-TP-2282; L-15681; NAS 1.60:2282) Avail: NTIS HC A04/MF A01 CSCL 01A

Improvements in transonic maneuver performance by the use of three-dimensional transonic theory and a transonic design procedure were examined. The FLO-27 code of Jameson and Caughey was used to design a new wing for a fighter configuration with lower drag at transonic maneuver conditions. The wing airfoil sections were altered to reduce the upper-surface shock strength by means of a design procedure which is based on the iterative application of the FLO-27 code. The plan form of the fighter configuration was fixed and had a leading edge sweep of 45 deg and an aspect ratio of 3.28. Wind-tunnel tests were conducted on this configuration at Mach numbers from 0.60 to 0.95 and angles of attack from -2 deg to 17 deg. The transonic maneuver performance of this configuration was evaluated by comparison with a wing designed by empirical methods and a wing designed primarily by two-dimensional transonic theory. The configuration designed by the use of FLO-27 had the same or lower drag than the empirical wing and, for some conditions, lower drag than the two-dimensional design. From some maneuver conditions, the drag of the two-dimensional design was somewhat lower. Author

N84-18162*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AN EXPERIMENTAL INVESTIGATION OF NACELLE-PYLON INSTALLATION ON AN UNSWEPT WING AT SUBSONIC AND TRANSONIC SPEEDS
J. R. CARLSON and W. B. COMPTON, III Feb. 1984 203 p refs
(NASA-TP-2246; L-15589; NAS 1.60:2246) Avail: NTIS HC A10/MF A01 CSCL 01A

A wind tunnel investigation was conducted to determine the aerodynamic interference associated with the installation of a long duct, flow-through nacelle on a straight unswept untapered supercritical wing. Experimental data was obtained for the verification of computational prediction techniques. The model was tested in the 16-Foot Transonic Tunnel at Mach numbers from 0.20 to 0.875 and at angles of attack from about 0 deg to 5 deg. The results of the investigation show that strong viscous and compressibility effects are present at the transonic Mach numbers. Numerical comparisons show that linear theory is adequate for subsonic Mach number flow prediction, but is inadequate for prediction of the extreme flow conditions that exist at the transonic Mach numbers. S.L.

N84-18163*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
BODY AND CANARD EFFECTS ON AN ATTACHED-FLOW MANEUVER WING AT MACH 1.62
J. L. PITTMAN, D. S. MILLER, and W. H. MASON (Grumman Aerospace Corp., Bethpage, N.Y.) Feb. 1984 149 p refs
(NASA-TP-2249; L-15677; NAS 1.60:2249) Avail: NTIS HC A07/MF A01 CSCL 01A

A wing-body-canard configuration was tested at a Mach number of 1.62 by using both a cambered and an uncambered wing. The cambered wing was designed to produce efficient high lift by using attached supercritical crossflow and was originally tested as an isolated wing. The uncambered wing has the same planform and essentially the same thickness distribution as the cambered wing. The experiment determined the effects of a body and canards on both wings. The experimental data showed that both the body and the canards influenced the wing pressure levels, but that the attached supercritical crossflow, which was achieved in the isolated cambered-wing test, was maintained in the presence of a body and canards. Tables of experimental pressure, force, and moment data are included, as well as photographs of oil flow patterns on the upper surface. S.L.

N84-18164*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
INVESTIGATION OF TRAILING-EDGE-FLAP, SPANWISE-BLOWING CONCEPTS ON AN ADVANCED FIGHTER CONFIGURATION
J. W. PAULSON, JR., P. F. QUINTO, and D. W. BANKS Mar. 1984 107 p refs
(NASA-TP-2250; L-15627; NAS 1.60:2250) Avail: NTIS HC A06/MF A01 CSCL 01A

The aerodynamic effects of spanwise blowing on the trailing edge flap of an advanced fighter aircraft configuration were determined in the 4 by 7 Meter Tunnel. A series of tests were conducted with variations in spanwise-blowing vector angle, nozzle exit area, nozzle location, thrust coefficient, and flap deflection in order to determine a superior configuration for both an underwing cascade concept and an overwing port concept. This screening phase of the testing was conducted at a nominal approach angle of attack from 12 deg to 16 deg; and then the superior configurations were tested over a more complete angle of attack

range from 0 deg to 20 deg at tunnel free stream dynamic pressures from 20 to 40 lbf/sq ft at thrust coefficients from 0 to 2. S.L.

N84-18166# National Aerospace Lab., Tokyo (Japan).
EXPERIMENT OF A SHOCKLESS TRANSONIC AIRFOIL
M. NAKAMURA, K. SUZUKI, S. NAKAMURA, and M. SHIRAI 1983 10 p refs In JAPANESE; ENGLISH summary
(NAL-TR-783; ISSN-0389-4010) Avail: NTIS HC A02/MF A01

An experiment was carried out on the transonic flows over an airfoil which was partially modified from an arbitrary airfoil. The modification was made to satisfy the shockless condition which predicted on NAL TR-602, TR-602T. Static pressures were measured at 88 points on the airfoil surface, when the test Mach number was 0.5-0.8, the test angle of attack was 0 deg - 4 deg and the Reynolds number was 4.0 - 4.6 x 10(6). A shockless transonic flow was observed under a test condition close to the design condition. The supersonic region extends from 0.3% of airfoil chord length and the local maximum Mach number is 1.36. The result of this experiment supports the artificial flow method for obtaining shockless transonic airfoils which are partially modified from an arbitrary airfoil. Author

N84-18167# National Aerospace Lab., Tokyo (Japan).
CALCULATION OF THREE-DIMENSIONAL FLYING OBJECT IN SHOCKLESS TRANSONIC FLOW
M. NAKAMURA 1983 12 p refs In JAPANESE; ENGLISH summary
(NAL-TR-782; ISSN-0389-4010) Avail: NTIS HC A02/MF A01

The artificial flow method for obtaining shockless transonic airfoils which are partially modified from an arbitrary airfoil is extended to cover three-dimensional flows. In order to confirm the extended three dimensional artificial flow method, a numerical simulation of a quasi-aircraft is carried out in a physical plane. The quasi-aircraft is made up of a body, a sweepback wing and a tail unit and it has no lift. Under design conditions of a free stream mach number of 0.87 and an angle of attack of 0 deg the quasi-aircraft is partially modified and a shockless transonic quasi-aircraft is obtained numerically. The potential flow is used and the flow model has the effects of the walls of a wind tunnel. Author

N84-18168# National Aerospace Lab., Tokyo (Japan).
DOUBLET POINT METHOD FOR CALCULATIONS ON OSCILLATORY LIFTING SURFACES. PART 1: SUBSONIC FLOW
T. UEDA 1983 15 p refs In JAPANESE; ENGLISH summary
(NAL-TR-781-PT-1; ISSN-0389-4010) Avail: NTIS HC A02/MF A01

A simple method for calculating the unsteady aerodynamic loadings on harmonically oscillating thin wings in subsonic flow was developed. The method is based on a concept of concentrated lift forces. The wing is divided into the element surfaces on which lift distributions are represented by single concentrated lift forces. Since the procedure does not include any quadratures, it is easily applied to calculate the unsteady aerodynamic loadings on complex planform wings even when they have partial span control surfaces. Numerical calculations are carried out for various wing geometries and are compared with other analyses and experiments. Author

N84-18170*# National Aeronautics and Space Administration, Washington, D. C.
AIR INTAKES FOR A PROBATIVE MISSILE OF ROCKET RAMJET
G. LARUELLE Jan. 1984 33 p refs Transl. into ENGLISH from L'Aeron. et L'Astronautique (France), no. 98, 1983 p 47-59 Original language document was announced as A83-31824 Transl. by Kanner (Leo) Associates, Redwood City, Calif.
(Contract NASW-3541)
(NASA-TM-77407; NAS 1.15:77407) Avail: NTIS HC A03/MF A01 CSCL 01A

The methods employed to test air intakes for a supersonic guided ramjet powered missile being tested by ONERA are described. Both flight tests and wind tunnel tests were performed on instrumented rockets to verify the designs. Consideration as given to the number of intakes, with the goal of delivering the maximum pressure to the engine. The S2, S4, and S5 wind tunnels were operated at Mach nos. 1.5-3 for the tests, which were compartmentalized into fuselage-intake interaction, optimization of the intake shapes, and the intake performance. Tests were performed on the length and form of the ogive, the presence of grooves, the height of traps in the boundary layer, the types and number of intakes and the lengths and forms of diffusers. Attention was also given to the effects of sideslip, effects of the longitudinal and circumferential positions of the intakes were also examined. Near optimum performance was realized during Mach 2.2 test flights of the prototype rockets. M.S.K.

N84-18171*# Old Dominion Univ., Norfolk, Va. Dept. of Mechanical Engineering and Mechanics.
A MODIFIED LIFTING LINE THEORY FOR WING-PROPELLER INTERFERENCE Progress Report, 1 Jun. - 30 Sep. 1983
R. K. PRABHU and S. N. TIWARI Nov. 1983 32 p refs
(Contract NCC1-65)
(NASA-CR-173324; NAS 1.26:173324) Avail: NTIS HC A03/MF A01 CSCL 01A

An inviscid incompressible model for the interaction of a wing with a single propeller slipstream is presented. The model allows the perturbation quantities to be potential even though the undisturbed flow is rotational. The governing equations for the spanwise lift distribution are derived and a simple method of solving these is indicated. Spanwise lift and induced drag distribution for two cases are computed. Author

N84-18172# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
EXPERIMENTAL INVESTIGATION OF DYNAMIC STALL M.S. Thesis
D. C. DALEY Jul. 1983 82 p
(AD-A135846; AFIT/GAE/AA/82D-6) Avail: NTIS HC A05/MF A01 CSCL 20D

This thesis discusses an experimental investigation of dynamic stall for an NACA 0015 airfoil rotated at different constant angular rates. It describes a microcomputer-based automatic data acquisition system capable of acquiring 1000 items of data per second. When this information was used to predict stall and compared with film-data stall indications of the same test runs, there was excellent correlation between them. Results of the investigation showed a consistent correlation between the stall angle at dynamic conditions and the nondimensionalized angular rate. Experimental data was obtained for non-dimensional angular rates (defined as one half the chord times the angular rate divided by free stream velocity) in the range of .005 to .06. Author (GRA)

N84-18173# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
AN INVESTIGATION OF THE EFFECTS OF DISCRETE WING TIP JETS ON WAKE VORTEX ROLL UP Ph.D. Thesis - Tennessee Univ.
F. T. GILLIAM, JR. Aug. 1983 150 p
(AD-A135872) Avail: NTIS HC A07/MF A01 CSCL 20D

A water tunnel experiment and a computational flow field model show that discrete wing tip jets can strongly affect the roll up of the wing tip vortex and apparently decrease its rolled up strength at moderate levels of blowing. The key factor in vortex alleviation was the extent of the local flow interactions between the discrete jets and the developing wing tip vortex. Vortex trajectory in both the spanwise and vertical directions was influenced by the jets. An outboard shift of the wing tip vortex indicated that discrete wing tip jets may be able to produce improved wing aerodynamics during cruise flight. The counterrotating pair of vortices generated by a jet in a cross flow were clearly seen in the water tunnel and appeared to be very effective in reducing the intensity of the wing vortex system. Two types of periodic secondary vortices were also observed in the water tunnel for heavy jet blowing. These

were spin-off vortices which periodically developed in the rolling up tip vortex but rapidly spun outboard and above the wing; and entrained vortices which was a set of periodic vortices laterally connecting the wing tip vortex to the vortices embedded in the jet. These secondary vortices are oriented such that they will greatly accelerate the spreading of wake vorticity through the vortex stretching term of the Helmholtz equation. This influence was confirmed in the water tunnel tests. GRA

N84-18174# Dayton Univ., Ohio. Research Inst.
EFFECT OF SUCTION ON THE WAKE STRUCTURE OF A THREE-DIMENSIONAL TURRET Final Report, 1 Dec. 1982 - 17 Aug. 1983
S. C. PUROHIT Wright-Patterson AFB, Ohio AFWAL Oct. 1983 82 p
(Contract F33615-82-K-3021; AF PROJ. 2307)
(AD-A135897; UDR-TR-83-64; AFWAL-TR-83-3099) Avail: NTIS HC A05/MF A01 CSCL 20D

This report examines the flowfield over a three-dimensional turret when suction is applied to alter the wake structures. At a uniform rate of 0.136 kg/s, the numerical simulation of flow around a turret is accomplished through the solution of mass averaged unsteady compressible Navier-Stokes equations. The computation is performed, for a free stream Mach number 0.6 and Reynolds number 12.8 million/m, on the CRAY-1 computer utilizing 62 x 30 x 30 grid points. Using MacCormack's explicit finite difference scheme, the steady-state periodic solutions are achieved for the two cases when the turret is treated like a solid shell and a porous shell. The results are compared with available experimental data or known solution, and the numerical values for RMS density fluctuations and correlation coefficients are presented. Author (GRA)

N84-18175# Neilsen Engineering and Research, Inc., Mountain View, Calif.
EFFECTS OF BLOWING SPANWISE FROM THE TIPS OF LOW-ASPECT RATIO WINGS OF VARYING TAPER RATIO, WITH APPLICATION TO IMPROVING STOL CAPABILITY OF FIGHTER AIRCRAFT Final Report, 1 Apr. 1982 - 30 Sep. 1982
R. G. SCHWIND and M. M. BRIGGS Feb. 1983 93 p
(Contract F49620-82-C-0061; AF PROJ. 2307)
(AD-A135688; NEAR-TR-294; AFOSR-83-1045TR) Avail: NTIS HC A05/MF A01 CSCL 20D

Parametric low-speed wind tunnel testing of several low aspect ratio half-span wings featuring outboard-blowing wing-tip jets has been accomplished. This effort was performed to extend the existing information base regarding lift augmentation of low aspect ratio wings to encompass tapered wings suitable for application to high-performance fighter aircraft. At an angle of attack typical for fighter aircraft takeoff, operation of the wing-tip jets was found to augment the lift coefficient of aspect ratio two wings by 25% to 35%, depending upon the value of the jet momentum coefficient and the wing taper ratio. At low angles of attack, the wing lift coefficients were augmented by as much as 120%, but the amount of lift augmentation decreased in inverse proportion to wing angle of attack. The worth of blowing outboard from the wing tips of fighter aircraft as a means of enhancing STOL performance was assessed. Diverting 70% of the engine bypass airflow to the wing tips reduced predicted takeoff and landing distances by 15%. Differential left-wing-tip-to-right-wing-tip modulation of the jet momentum can immediately produce up to 15,000 ft-lbs of additional roll control torque during low-speed landing approaches. Author (GRA)

N84-18176# Ballistic Research Labs., Aberdeen Proving Ground, Md.
NAVIER-STOKES COMPUTATIONS OF PROJECTILE BASE FLOW AT TRANSONIC SPEEDS WITH AND WITHOUT BASE INJECTION Final Report
J. SAHU, C. J. NIETUBICZ, and J. L. STEGER Nov. 1983 39 p
(Contract DA PROJ. 1L1-61102-AH-43)
(AD-A135783; AD-F300350; ARBRL-TR-02532) Avail: NTIS HC A03/MF A01 CSCL 19D

A computational capability has been developed for predicting the flow field about the entire projectile, including the recirculatory base flow, at transonic speeds. Additionally, the computer code allows mass injection at the projectile base and hence is used to show the effects of base bleed on base drag. Computations have been made for a secant-ogive-cylinder projectile for a series of Mach numbers in the transonic flow regime. Computed results show the qualitative and quantitative nature of base flow with and without base bleed. The reduction in base drag with base bleed is clearly predicted for various mass injection rates and for Mach numbers .9 M 1.2. The encouraging results obtained indicate that this computational technique may provide useful design guidance for shell with base bleed. GRA

N84-18177# Ballistic Research Labs., Aberdeen Proving Ground, Md.
WIND TUNNEL TESTS ON A NONAXISYMMETRIC PROJECTILE SHAPE AT MACH NUMBERS 2.5 TO 6.0 Final Report
L. D. KAYSER Sep. 1983 49 p
(Contract DA PROJ. 1L1-62618-AH-80)
(AD-A135784; AD-F300332; ARBRL-MR-03308) Avail: NTIS HC A03/MF A01 CSCL 19A

Wind tunnel tests on spinning nonaxisymmetric projectile configurations at Mach numbers of 2.5 to 6.0 are reported. The projectile shapes are ogive- cylinder bodies which have been modified by machining three forward facing surfaces and three rearward facing surfaces on the projectile. The machined surfaces are twisted at a rate corresponding to a typical rifling twist. The forward facing surfaces produce a helical or corkscrew type effect and the rearward surfaces form a nonconical boattail and a triangular base. The objective of the test program was to study shapes which have improved stability characteristics which require less gyroscopic stabilization. A more slender, longer L/d projectile can then be flown which has lower drag and shorter time of flight to a moving target. GRA

N84-18178# Naval Surface Weapons Center, White Oak, Md.
HIGH ALTITUDE MANEUVER CONTROL TESTS IN THE NSWC (NAVAL SURFACE WEAPONS CENTER) HYPERVELOCITY WIND TUNNEL
B. D. PRATS, M. A. METZGER, and J. A. F. HILL Jan. 1983 30 p
(Contract Z1259)
(AD-A136105; NSWC/MP-83-82) Avail: NTIS HC A03/MF A01 CSCL 20D

Pressure tests were conducted in the NSWC Hypervelocity Wind Tunnel to obtain aerodynamic data on high-performance missile interceptor vehicles which are controlled by large jets issuing laterally from the vehicle. Reproduction of flight Reynolds number was of particular interest since for large lateral jets extensive separation can occur. The tests were conducted at nominal Reynolds numbers of 2.0, 3.2 and 4.6 million per ft., and at Mach numbers of 10 and 14. Model orientations included angles of attack from -15 to +15 deg and vehicle roll angles of 0, 45 and 90 deg. The tests provided surface pressure distributions over the 112 orifice locations and shock shapes and separation data from the Schlieren photographs. These results constitute an advancement over past tests and provide guidance in calculating jet penetration, jet spreading and separation on high-altitude maneuver control vehicles and in calculating 3-D effects of jets on surface pressure. GRA

N84-18179# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
AEROSPACE RESEARCH ACTIVITIES Annual Report, 1982
1983 213 p refs Original contains color illustrations
Avail: NTIS HC A10/MF A01

Research concerning aerospace structural design and testing, aeroelasticity, fracture mechanics, instrumentation, aeroacoustics, fiber reinforced directionally solidified eutectics, powders for turbine component fabrication, and high temperature corrosion and oxidation protection methods is reviewed. Investigations of flow in aerospace power units; wind tunnel test facilities; parallel processing; and numerical and applied aerodynamics programs are described. Author (ESA)

N84-18180# Aeronautical Research Inst. of Sweden, Stockholm. Aerodynamics Dept.
DEVELOPMENT OF A COMPUTER CODE FOR 3-DIMENSIONAL HIGHER ORDER PANEL METHOD FOR SUBSONIC POTENTIAL FLOW
L. E. ERIKSSON 7 Aug. 1983 78 p refs
(Contract FMV-F-K-82223-78-003-21-001; FMV-F-K-82223-78-170-21-001; FMV-F-K-8223-80-183-21-001)
(FFA-138; ISSN-SW-0081-5640) Avail: NTIS HC A05/MF A01; Aeronautical Research Inst. of Sweden, Stockholm SEK 70

A computer code for the computation of subsonic inviscid flow around wings and wing-body configurations was developed using the boundary integral method. The method is based on independent surface networks with piecewise linear source distributions and piecewise quadratic dipole distributions. The effect of surface curvature is included. Numerical tests and comparisons indicate that the method gives accurate results, which are insensitive to the surface discretization. Author (ESA)

N84-18181# National Aerospace Lab., Amsterdam (Netherlands). Fluid Dynamics Div.
UNSTEADY VISCOUS TRANSONIC FLOW COMPUTATIONS USING LTRAN2-NLR CODE COUPLED WITH GREEN'S LAG-ENTRAINMENT METHOD
R. HOUWINK 22 Nov. 1982 11 p refs Presented at 2nd Symp. on Numerical and Phys. Aspects of Aerodyn. Flows, Long Beach, Calif., 17-20 Jan. 1983 Sponsored by the Netherlands Agency for Aerospace Programs (NIVR)
(NLR-MP-82052-U) Avail: NTIS HC A02/MF A01

Results of unsteady inviscid and viscous transonic flow computations are compared with experimental data for the NACA64A006 airfoil with oscillating flap, for the NACA64A010 airfoil and for a supercritical airfoil oscillating in pitch. The computations were performed using the NLR version of the LTRAN2 computer code, coupled with the Green's lag-entrainment method for a turbulent boundary layer. The computed effect of the boundary layer on the unsteady airloads (reduction of the magnitude and a positive phase shift) leads to a better agreement with experimental data. The remaining differences may be due to the low frequency small perturbation potential approximation, the weak interaction modeling and wall interference effects. Unsteady boundary layer methods and Green's steady method predict similar effects of the boundary layer on the unsteady airloads. Author (ESA)

N84-19281*# Boeing Commercial Airplane Co., Seattle, Wash.
AN ANALYSIS OF PROP-FAN/AIRFRAME AERODYNAMIC INTEGRATION Final Report
M. L. BOCTOR, C. W. CLAY, and C. F. WATSON Oct. 1978 74 p refs
(Contract NAS2-9104)
(NASA-CR-152186; NAS 1.26:152186; D6-47113) Avail: NTIS HC A04/MF A01 CSCL 01A

An approach to aerodynamic integration of turboprops and airframes, with emphasis placed upon wing mounted installations is addressed. Potential flow analytical techniques were employed to study aerodynamic integration of the prop fan propulsion concept with advanced, subsonic, commercial transport airframes. Three basic configurations were defined and analyzed: wing mounted prop fan at a cruise Mach number of 0.8, wing mounted prop fan in a low speed configuration, and aft mounted prop fan at a cruise Mach number of 0.8. Author

N84-19282*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
DELTA WINGS WITH SHOCK-FREE CROSS FLOW Final Report
S. S. SRITHARAN Feb. 1984 27 p refs
(Contract NAS1-17070)
(NASA-CR-172297; NAS 1.26:172297; REPT-84-6) Avail: NTIS HC A03/MF A01 CSCL 01A

In order to have a high level of maneuverability, supersonic delta wings should have a cross flow that is free of embedded shock waves. The conical cross flow sonic surface differs from that of plane transonic flow in many aspects. Well-known properties such as the monotone law are not true for conical cross flow sonic surfaces. By using a local analysis of the cross flow sonic line, relevant conditions for smooth cross flow are obtained. A technique to artificially construct a smooth sonic surface and an efficient numerical method to calculate the flow field are used to obtain cones with smooth cross flow. A.R.H.

N84-19283*# Virginia Univ., Charlottesville. Dept. of Mechanical and Aerospace Engineering.
FLOWFIELD MEASUREMENTS IN A MODEL SCRAMJET COMBUSTION USING LASER-INDUCED IODINE FLUORESCENCE Semiannual Progress Report, 1 Jul. 1983 - 1 Jan. 1984
J. C. MCDANIEL, JR. Mar. 1984 19 p
(Contract NAG1-173)
(NASA-CR-175399; NAS 1.26:175399; UVA/528228/MAE84/101) Avail: NTIS HC A02/MF A01 CSCL 01A

Preliminary designs were completed for an iodine mixing chamber and the optical setup to be used with a modified wind tunnel in obtaining accurate, spatially resolved measurements of variables in the flowfield of a model nonreacting scramjet combustor. Schematics of the iodine-seeded wind tunnel and a sketch of the charcoal filter for removing the iodine are included along with a cutaway section of the laboratory. A.R.H.

N84-19284*# Old Dominion Univ., Norfolk, Va. Dept. of Mechanical Engineering and Mechanics.
AN ANALYTICAL DESIGN PROCEDURE FOR THE DETERMINATION OF EFFECTIVE LEADING EDGE EXTENSIONS ON THICK DELTA WINGS Final Report
F. GHAFFARI and S. K. CHATURVEDI Feb. 1984 83 p refs
(Contract NAS1-17099)
(NASA-CR-175395; NAS 1.26:175395) Avail: NTIS HC A05/MF A01 CSCL 01A

An analytical design procedure for leading edge extensions (LEE) was developed for thick delta wings. This LEE device is designed to be mounted to a wing along the pseudo-stagnation stream surface associated with the attached flow design lift coefficient of greater than zero. The intended purpose of this device is to improve the aerodynamic performance of high subsonic and low supersonic aircraft at incidences above that of attached flow design lift coefficient, by using a vortex system emanating along the leading edges of the device. The low pressure associated with these vortices would act on the LEE upper surface and the forward facing area at the wing leading edges, providing an additional lift and effective leading edge thrust recovery. The first application of this technique was to a thick, round edged, twisted and cambered wing of approximately triangular planform having a sweep of 58 deg and aspect ratio of 2.30. The panel aerodynamics and vortex lattice method with suction analogy computer codes were employed to determine the pseudo-stagnation stream surface and an optimized LEE planform shape. Author

N84-19285*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ON THE STABILITY OF AN INFINITE SWEPT ATTACHMENT LINE BOUNDARY LAYER Final Report
P. HALL (Imperial College), M. R. MALLIK (High Technology Corp.), and D. I. A. POLL (Cranfield Inst. of Technology) Feb. 1984 46 p refs
(Contract NAS1-17070; NAS1-16916; NAS1-14605)
(NASA-CR-172300; ICASE-84-5; NAS 1.26:172300) Avail: NTIS HC A03/MF A01 CSCL 01A

The instability of an infinite swept attachment line boundary layer is considered in the linear regime. The basic three dimensional flow is shown to be susceptible to travelling wave disturbances which propagate along the attachment line. The effect of suction on the instability is discussed and the results suggest that the attachment line boundary layer on a swept wing can be significantly stabilized by extremely small amounts of suction. The results obtained are in excellent agreement with the available experimental observations. Author

N84-19287*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
TESTS OF A NACA 65(SUB 1)-213 AIRFOIL IN THE NASA LANGLEY 0.3-METER TRANSONIC CRYOGENIC TUNNEL
E. B. PLENTOVICH, C. L. LADSON, and A. S. HILL Feb. 1984 99 p
(NASA-TM-85732; NAS 1.15:85732) Avail: NTIS HC A05/MF A01 CSCL 01A

A wind-tunnel investigation was conducted to study the two dimensional aerodynamic characteristics of the NACA 65 sub 1-213 airfoil over a wide range of Reynolds numbers. Test temperature ranged from ambient to about 100K at pressures ranging from about 1.2 to 6.0 atm. Mach number was varied from 0.22 to 0.80 and Reynolds number (based on airfoil chord) from 3 million to 40 million. Data are included which demonstrate the effects of fixed transition, Mach number, and Reynolds number on the aerodynamic characteristics of the airfoil. A sample of data showing the effects of angle of attack on the pressure distribution is also given. The data are presented in an uncorrected form with no analysis. S.L.

N84-19288# Naval Postgraduate School, Monterey, Calif.
EXPERIMENTAL DETERMINATION OF THE RELATIVE FLOW AT THE TIP OF A TRANSONIC AXIAL COMPRESSOR ROTOR Engineers Thesis
D. W. CORNELL Sep. 1983 224 p
(AD-A137483) Avail: NTIS HC A10/MF A01 CSCL 20D

The goal in the present work was to examine the flow through the tip section of a transonic compressor rotor in three different ways: (1) using high response instrumentation in the compressor itself, (2) using a blow-down wind tunnel model of the relative flow at the rotor tip, and (3) using a new computer analysis code. Toward that goal, the present study reports the results of extensive measurements made in the compressor and software developed to acquire and reduce high response transducer data. Modifications made to the cascade and first results of applying S. Eidelman's Godunov code to the compressor rotor tip section are also included. It was concluded that a valid comparison of computed and measured results required both an improvement of the compressor in-flow and an extension of the analysis code to include three dimensional effects. Author (GRA)

N84-19289# Ballistic Research Labs., Aberdeen Proving Ground, Md.
NUMERICAL INVESTIGATION OF THE AERODYNAMICS AND STABILITY OF A FLARED AFTERBODY FOR AXISYMMETRIC PROJECTILES AT SUPERSONIC SPEEDS Final Report
M. J. NUSCUA Dec. 1983 56 p
(Contract DA PROJ. 1L1-62618-AH-80)
(AD-A136826; AD-F300363; ARBRL-TR-02535) Avail: NTIS HC A04/MF A01 CSCL 19A

A parametric study has been conducted for eight similar axisymmetric, spin stabilized projectile shapes. The aerodynamic and stability parameters of flared projectile afterbodies at freestream Mach numbers of 2, 3 and 4 and at an angle of attack of 2 deg have been determined. The projectiles under investigation has an ogive nose, a cylindrical midsection and one of three afterbodies: an extended cylinder, a boattail (conical frustum), and a boattail-flare (two conical frustums end to end). Total projectile lengths of 6 and 7 calibers have been studied. Finite difference solutions of the Navier-Stokes equations, the method of characteristics, and semi-empirical models are used to predict normal force, static pitching moment, total drag, Magnus moment, roll damping and pitch damping. Estimations of gyroscopic and dynamic stability parameters are then made. This study determined that the boattail-flare renders the ogive nose and cylindrical midsection projectile configuration more gyroscopically and dynamically stable than the conventional boattail afterbody. Results also showed that the boattail-flare afterbody decreases the Magnus moment but increases total drag therefore providing a stability advantage at the expense of reduced range. This stability advantage can be utilized in long spin-stabilized projectiles as well as long rod penetrators where fin stabilization has been replaced by a boattail-flare. Future work may be aimed at utilizing present computational techniques as a design tool in the use of a flared afterbody for stable, reduced range projectiles. GRA

N84-19290# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
A STUDY OF THE AERODYNAMIC INTERFERENCE EFFECTS DURING AERIAL REFUELING M.S. Thesis
E. H. HOGANSON Dec. 1983 100 p
(AD-A136895; AFIT/GAE/AA/83D-8) Avail: NTIS HC A05/MF A01 CSCL 20D

This report investigated the feasibility of using an analytical approach and the vortex lattice method (VLM) to evaluate aerodynamic interference effects present during aerial refueling. While KC-10 tanker and a B-52 receiver were studied, the method applies to any tanker receiver combination. Major assumptions include: linear potential flow; tanker receiver are represented by wing planforms; fuselage effects are small; and the rolling-up process of the tanker's wing tip vortices are not considered. The analytical approach uses a lifting line followed by a semi-infinite vortex sheet to represent the tanker. Three linear lift distributions for the tanker's wing were used and equations were derived for the induced downwash at any point in space. Points on the receiver's wing were selected to indicate the tanker's effect on the receiver's flowfield. Results of the analytical equations when compared with analytical predictions were found to overpredict the induced downwash by 25-35%. VLM was used to study the effects of: rectangular vs swept wings on induced downwash; tanker tailplane on the receiver; change of angle of attack of one aircraft due to the presence of the other; and the presence of the tanker on th receiver's pitching moment. VLM results varied from the Douglas prediction for induced downwash by only 5% and were even more accurate at lower tanker angles of attack. GRA

N84-19291# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
INVESTIGATION OF EFFECTS CONTRIBUTING TO DYNAMIC STALL USING A MOMENTUM-INTEGRAL METHOD M.S. Thesis
J. S. LAWRENCE Dec. 1983 108 p
(AD-A136897; AFIT/GAE/AA/83D-12) Avail: NTIS HC A06/MF A01 CSCL 20D

Dynamic stall effects are analyzed in this investigation for cases of an inertially static airfoil in a flow field rotating at constant rate (gust response), and an airfoil pitching at constant rate in a steady flow field. The method used is a boundary layer solution of the momentum-integral equation by a modified von Karman-Pohlhausen technique. Previous work using this method to match Kramer's experimental results for gust response is reviewed, corrected, and continued. The validity of the closure equation and the assumptions key to its derivation are examined, concluding that the closure equation is justified. A better match of Kramer's airfoil sections results in dynamic stall predictions very close to experimental data.

The effect of varying airfoil thickness and camber is investigated. By consideration of the non-Newtonian motion of the boundary layer on the surface of a pitching airfoil, the momentum-integral method is extended to the second case. Using the Moore-Rott-Sears model for flow separation criteria, analytical results were computed and compared with experimental data. Reduction in adversity of the pressure gradient accounts for only a fraction of the total dynamic effect, and it is proposed that mass introduction into the boundary layer from the free stream may be a strongly contributing factor. This phenomena is demonstrated to have a large effect, and an argument is presented for the proper amount of mass introduction. GRA

N84-19292# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
A WIND TUNNEL INVESTIGATION TO DETERMINE DOMINANT FOREBODY STRAKE DESIGN CHARACTERISTICS FOR AN F-15 EQUIPPED WITH CONFORMAL FUEL TANKS M.S. Thesis
T. A. DUNCAN Dec. 1983 127 p
(AD-A136912; AFIT/GAE/AA/83D-7) Avail: NTIS HC A07/MF A01 CSCL 20D

A parametric study was made in the AFIT 5-ft wind tunnel of forebody strakes on an F-15C model equipped with conformal fuel tanks. Parameters of interest were strake planform area and strake angle of incidence. Twenty configurations were evaluated for longitudinal and lateral stability at angles of attack from -4 to 46 deg. Lift coefficient, drag coefficient, and pitching moment coefficient (CM) were plotted angle of attack (alpha). Data indicated that an excessive positive increase in the derivative of CM/derivative of alpha can be expected at angles of attack of 20 deg or less. Above 20 deg, CM may be tailored by varying the strake area and incidence angle. For each strake examined, and angle of incidence of either -3 or -6 deg (depending on planform area) produced a more nearly linear CM vs alpha curve than 0 degrees; therefore, incidence angle should be considered in strake design optimization. Lateral stability data were taken on 12 configurations from 16 to 44 deg angle of attack. To determine spin susceptibility, the parameter for predicting lateral-directional stability was plotted for the most promising configurations. Very little constructive change in lateral stability was noted for the configurations tested. GRA

N84-19293# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
THE EFFECT OF CONSTANT VERSUS OSCILLATORY RATES ON DYNAMIC STABILITY DERIVATIVES M.S. Thesis
M. S. LARSON Dec. 1983 101 p
(AD-A136913; AFIT/GAE/ENY/83D-11) Avail: NTIS HC A06/MF A01 CSCL 20D

The purpose of this thesis was to determine whether or not there are phenomenological differences between dynamic derivations calculated from F-15A rotary balance data and data from other sources. To make this determination, two additional data sets were obtained: (1) the F-15A design phase stability derivative data, and (2) the F-15A production phase stability derivative data. The lateral dynamic derivatives were then compared through derivatives of the lateral moments with respect to the rotation rate about the velocity vector (wind vector). The conclusion of the project was that differences exist between the data sets, but that the dominant characteristics were the same for all of the data sets; the differences in the data were not indicative of basic (phenomenological) the differences in the data itself. Therefore, the contention that oscillatory rates affect determination of the dynamic derivations was not substantiated by this study. Author (GRA)

N84-19294# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
CONTINUED EXPERIMENTAL INVESTIGATION OF DYNAMIC STALL M.S. Thesis
S. J. SCHRECK Dec. 1983 147 p
(AD-A136920; AFIT/GAE/AA/83D-21) Avail: NTIS HC A07/MF A01 CSCL 20D

Flow over an NACA 0015 airfoil undergoing a constant rate of change of angle of attack was experimentally studied over a range of tunnel speeds and rotation rates. Surface pressure transducers coupled with a microcomputer-based data acquisition system were used to collect surface-pressure data at the rate of 4000 samples per second; data reduction was also microcomputer-based. Data was reduced in two forms: (1) C sub l versus alpha curves through stall were determined for each dynamic experimental configuration. This was accomplished by numerical integration of pressure data at a number of angles through stall, each data point representing the average of five experiments at the same experimental conditions. These curves indicated a slight decrease in C sub l - alpha slope with increasing angle of attack angular rate. (2) Increase in stall angle of attack of the dynamic over the static case was plotted against a nondimensional angular rate parameter (defined as the product of one-half the chord length and angular rotation rate, divided by the freestream velocity). This comparison gave rise to an apparently universal curve of nondimensional angular rotation rate versus increase in stall angle of attack. This curve was in agreement in some sense with previous experiments using stall indicators other than the actual stall. GRA

N84-19295# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
THE EFFECT OF TRAILING VORTICES ON THE PRODUCTION OF LIFT ON AN AIRFOIL UNDERGOING A CONSTANT RATE OF CHANGE OF ANGLE OF ATTACK M.S. Thesis
K. W. TUPPER Dec. 1983 81 p
(AD-A136921; AFIT/GAE/AA/83D-24) Avail: NTIS HC A05/MF A01 CSCL 20D

The purpose of this study was to investigate the effect a trailing vortex wake has on an airfoil undergoing a constant rate of change of angle of attack, alpha, in two dimensional, incompressible, irrotational flow. Potential flow theory, conformal mapping by the Joukowski transformation, and numerical integration and differentiation techniques were used to develop a computer algorithm to model the problem. Once the program was formulated, it was used to solve the impulsive-start problem of airfoil motion. The results were found to be in excellent agreement with the results obtained by others. When applied to the constant rate-of-change of angle-of-attack problem, the results showed that a trailing vortex wake has a measurable and predictable effect on the production of lift on an airfoil undergoing a constant alpha. While results of this work, taken alone, are helpful in understanding the phenomena known as dynamic stall, coupled with existing boundary-layer studies the results may lead to additional understanding of the phenomena. More specifically, the computer program developed here could be used to predict more realistically the inviscid flow about a pitching airfoil as it approaches the dynamic-stall conditions. GRA

N84-19296# Naval Ship Research and Development Center, Bethesda, Md.
A TIME DOMAIN ANALYSIS OF A RIGID TWO-BLADED FULLY GIMBALLED HELICOPTER ROTOR WITH CIRCULATION CONTROL Final Report
P. S. MONTANA Dec. 1983 88 p
(Contract ZR0-2302)
(AD-A136947; AD-E001638; DTNSRDC-83/081; AERO-1282)
Avail: NTIS HC A05/MF A01 CSCL 20D

An analytic investigation was made to determine the dynamic properties of a two-bladed rigid fully gimballed helicopter rotor incorporating circulation control airfoils and tip jet propulsion. A time domain analysis was developed which provided the capability of using nonlinear airfoil aerodynamics and arbitrary rotor physical characteristics. The effects of feather principal axis of inertia

location, horizontal gust disturbances, and feedback control on rotor stability were assessed. Results of the investigation indicate that the subject helicopter rotors are unstable in forward flight without feedback control. With feedback, the rotors are stable and controllable. Author (GRA)

N84-19297# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
AN INVESTIGATION OF NEW POSSIBILITIES TO SIMPLIFY THE STANDARD SUPERSONIC AREA RULE M.S. Thesis
V. R. NIKOLIC Dec. 1983 101 p
(AD-A137018; AD-E750174; AFIT/GAE/AA/83D-16) Avail: NTIS HC A06/MF A01 CSCL 20D

An investigation was conducted to find out whether there are possibilities to construct a procedure capable of giving reasonably accurate results for the aircraft wave drag coefficient over a range of Mach numbers or, at least, to predict the wave drag changes due to configuration changes. The idea was to build an algorithm starting from the standard supersonic area rule but employing different definitions for the area distribution along the longitudinal axis as applied to the equivalant body of revolution. Instead of using the set of planes tangent to the characteristic Mach cones, lateral surfaces of the cones were used. A computer program to perform the calculations following the procedure proposed was written. Several aircraft configurations were investigated by employing the developed method and very promising results for a particular type of supersonic aircraft configuration at moderate supersonic speeds were obtained. When applied to predict the wave drag of a configuration employing a thin wing of small aspect ratio centrally mounted on a slender fuselage at Mach numbers between 1.4 and 2.0, the method gave results within a range of ten percent accuracy. GRA

N84-19300# Massachusetts Inst. of Tech., Cambridge. Dept. of Aeronautics and Astronautics.
SOME UNSTEADY AERODYNAMIC CHARACTERISTICS OF SEPARATED AND ATTACHED FLOW Annual Report, 1 Sep. 1982 - 31 Sep. 1983
E. E. COVERT, P. F. LORBER, and C. M. VACZY 31 Aug. 1983 59 p
(Contract AF PROJ. 2307)
(AD-A137070; AFOSR-83-1344TR) Avail: NTIS HC A04/MF A01 CSCL 20D

Aerodynamic characteristics of separated and attached unsteady flow about a NACA 0012 airfoil have been measured for reduced frequency from 0 to 6.4 and angles of attack up to 18 deg. Results from boundary layer and near wake ensemble averaged velocity, Reynolds stress and surface pressure distributions are presented. The flow was determined to be locally two dimensional away from the separation point (if present), within + or - 1/4 span of the airfoil centerline. A convected component of the unsteady separated pressure field was identified, and the dependence on reduced frequency, angle of attack, Reynolds number and form of transition is discussed. A geometric similarity model is suggested to explain the presence of a periodic component measured for the ensemble averaged Reynolds stresses. Finally, studies of the relative importance of acoustic and upwash velocity components of the excitation are summarized. Author (GRA)

N84-19301# Eidgenoessisches Flugzeugwerk, Emmen (Switzerland). Versuchs- und Forschungsanlage.
COMPARATIVE FORCE MEASUREMENTS ON HALF AND WHOLE MODELS OF A HEAVY LIFT WING IN THE LARGE WIND TUNNEL EMMEN [VERGLEICHENDE KRAFTMESSUNGEN AN HALB- UND GANZMODELLEN EINES HOCHAUFTRIEBSFLUEGELS IM GROSSEN WINDKANAL EMMEN]
H. KAMBER Apr. 1982 47 p refs In GERMAN Presented at DGLR Fachausschuss-Sitzung ueber Halbmodell-Versuchstech., Goettingen West Germany, 3-4 Dec. 1981
(F/W-50-1596) Avail: NTIS HC A03/MF A01

Measurements were performed on heavy lift wing models in a wind tunnel. The results show that the boundary layer plate developed for half-models agrees well with whole-models in the case of heavy lift wing flaps. This makes it possible to use the half-model technique for design and optimization of heavy lift wings. Compared to whole-model measurements Reynolds numbers are square root of 2 times higher, the accuracy is higher, and the costs are lower. The Maskell method for wake blocking wind tunnel corrections is discussed. Author (ESA)

N84-19302# Bonn Univ. (West Germany). Sonderforschungsbereich 72.
COMFLO: AN EXPERIMENTAL PROGRAM FOR MULTIGRID TREATMENT OF SUBSONIC POTENTIAL FLOWS PAST AIRFOIL PROFILES [COMFLO- EIN EXPERIMENTIERPROGRAMM ZUR MEHRGITTERBEHANDLUNG SUBSONISCHER POTENTIALSTROEMUNGEN UM TRAGFLAECHENPROFILE]
K. BECKER Jun. 1983 134 p refs In GERMAN Submitted for publication Sponsored by Deutsche Forschungsgemeinschaft
(PREPRINT-604) Avail: NTIS HC A07/MF A01

A test program to solve the full potential equation for subsonic flows was developed for multigrid components and the investigation of the accuracy of discretization and multigrid methods. The complete COMFLO computer program is enclosed. Author (ESA)

N84-19303# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Abt. Technische Akustik.
ON THE SIGNIFICANCE OF UNSTEADY SURFACE PRESSURES FOR AERODYNAMICALLY INDUCED INTERIOR NOISE OF AUTOMOBILES Ph.D. Thesis - Technische Univ., Berlin
W. DOBRZYNSKI Sep. 1983 130 p refs In GERMAN; ENGLISH summary
(DFVLR-FB-83-28) Avail: NTIS HC A07/MF A01; DFVLR, Cologne DM 30

Aerodynamically induced interior noise in passenger cars is investigated. Surface pressures and resulting interior noise were measured on a full-scale automobile in wind tunnel tests. Interior noise predictions based on theoretical interrelations were compared to measured data. It is concluded that high surface pressure originating even from highly localized flow separations on the car body tends to dominate interior noise. Farfield noise radiation from exterior flow/car-body interaction was studied and results show that a noise level reduction of 4 dB is possible. Author (ESA)

N84-19304# Technische Hogeschool, Delft (Netherlands). Dept. of Aerospace Engineering.
A SURVEY OF THE CONTROL SYSTEM ANALYSIS AND SYNTHESIS PROGRAM (CASPAR) PACKAGE FOR AEROSPACE RESEARCH
J. A. HOOGSTRATEN Feb. 1983 54 p refs
(VTH-LR-336) Avail: NTIS HC A04/MF A01

The program package CASPAR (Control system Analysis and Synthesis Program package for Aerospace Research) for the development and evaluation of linear time-invariant systems is introduced. The program package consists of independent batch-executable modules. Program use is facilitated through a set of command list programs which aid the user in preparing a job for execution. Command list program use is illustrated with an

application to the design of a glide-path-hold control law for a B-747 aircraft in approach configuration. Author (ESA)

N84-19305# Technische Hogeschool, Delft (Netherlands). Dept. of Aerospace Engineering.
WIND TUNNEL TESTS ON AN OUTER WING SEGMENT OF THE ASW-19X SAILPLANE
L. M. M. BOERMANS and B. OOLBEKKING Jan. 1983 24 p refs
(VTH-LR-369) Avail: NTIS HC A02/MF A01

The aerodynamic characteristics of an outer wing segment of the ASW-19X sailplane were studied using airfoils designed so that by adding material to the surface the existing wing could be modified and tested in flight. Pneumatic turbulators were put on the lower surface. Wind tunnel tests on the inner wing airfoil section show a considerable drag decrease, and similar tests on an outer wing segment are described. Tests with a tape with bumps instead of the pneumatic turbulators are described. Wool tufts filmed by a camera mounted on a sting on top of the fuselage indicate flow separation on the downward deflected aileron in circling flight. Author (ESA)

N84-19905# McDonnell-Douglas Corp., St. Louis, Mo.
TESTING FOR SEVERE AERODYNAMICALLY INDUCED VIBRATION ENVIRONMENTS
H. N. ROOS and G. R. WAYMON *In* Shock and Vibration Inform. Center The Shock and Vibration Bull., part 3 p 155-159 May 1983 refs
Avail: SVIC, Code 5804, Naval Research Lab., Washington, D.C. 20375 CSCL 01A

Low speed wind tunnel and flight testing were conducted to evaluate F-15 vertical tail vibration response to excitation from separated airflow at high angles of attack. Good correlation was obtained between wind tunnel and flight vibration data. Flow visualization tests done in the wind tunnel determined that the separated flow effecting the tails comes from the mid-span leading edge of the wing. A special high-amplitude laboratory vibration exciter system was developed to duplicate the tail vibration level and to qualify all tail mounted equipment. M.G.

03

AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

A84-24103*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
NASA'S B-57B GUST GRADIENT PROGRAM
D. CAMP, W. CAMPBELL (NASA, Marshall Space Flight Center, Huntsville, AL), W. FROST (Tennessee, University, Space Institute, Tullahoma, TN), H. MURROW (NASA, Langley Research Center, Hampton, VA), and W. PAINTER (NASA, Flight Research Center, Edwards, CA) Journal of Aircraft (ISSN 0021-8669), vol. 21, March 1984, p. 175-182.
(AIAA PAPER 83-0208)

The B-57B Gust Gradient Program is a joint effort of NASA Headquarters, Marshall Space Flight Center, Dryden Flight Research Facility, Langley Research Center, and Ames Research Center. The primary program goal is to measure spanwise variations of turbulent gusts across an airflow. To this end, the NASA B-57B aircraft was equipped with three component gust probes on each wing tip and on the nose. Early results of flights done in conjunction with the Joint Airport Weather Studies (JAWS) project are described. Author

A84-24194#
AERODYNAMIC EVALUATION OF A HELICOPTER ROTOR BLADE WITH ICE ACCRETION IN HOVER
J. D. LEE (Ohio State University, Columbus, OH) IN: Aerodynamic Testing Conference, 13th, San Diego, CA, March 5-7, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 181-186. refs
(AIAA PAPER 84-0608)

Ice formations accreted on the rotors of a UH-1H helicopter in hover in an artificial cloud were documented after landing by means of molds, tracings and stereo photographs. A selected set of the molds was used to cast replicas of the ice in preparation of models for a wind tunnel test program in full scale. For two cases, simple two-dimensional strips were tested as substitutes for the cast ice replicas. Pressure distributions and wake surveys were obtained and reduced to determine the aerodynamic effects of the replicated ice formations in terms of changes in drag and lift. Results from the documentation and from the wind tunnel test program are presented. Author

A84-25192#
ANALYSIS OF THE INFLUENCE OF THE LOAD FACTOR IN PLANNING AIRCRAFT TRANSPORT CAPACITY [ANALISI DELL'INFLUENZA DEL COEFFICIENTE DI RIEMPIMENTO IN FASE DI IMPOSTAZIONE DELLA CAPACITADI TRASPORTO DEI VELIVOLI]
G. GUERRA (Torino, Politecnico, Turin, Italy) Ingegneria (ISSN 0035-6263), Nov.-Dec. 1983, p. 309-320. In Italian. refs

A mathematical model of the factors affecting the profitability of passenger/transport aircraft in commercial-airline operation is developed and applied to sample aircraft of the 20-50-passenger class. The break-even load factor is defined as the ratio of payload (passengers, cargo, and mail) to capacity at which income covers the direct operating costs for a given flight. Since the direct operating costs in these aircraft are practically independent of load factor, load factor becomes the key parameter determining the margin (to be applied to indirect operating costs) and profit obtainable with a given aircraft on a particular route. Hence in choosing an aircraft capacity, airline management must balance the greater efficiency of larger aircraft with the potential risk of low load factors. Numerous graphs of the principal parameter relationships and a table of aircraft characteristics are provided. T.K.

N84-19307# European Space Agency, Paris (France).
DEVELOPMENTAL POSSIBILITIES AND RESTRICTIONS IN AIR TRANSPORT
Oct. 1983 96 p Transl. into ENGLISH of proceedings of the Entwicklungsmoeglichkeiten u. Restriktionen im Luftverkehr Forum, rept. DFVLR-Mitt-81-19 DFVLR, West Germany, 1981 Conf. held in Cologne, 14 May 1981 Original language document was announced as X83-76555
(ESA-TT-744; DFVLR-MITT-81-19) Avail: NTIS HC A05/MF A01; original German version available from DFVLR, Cologne DM 16.20

The outlook for civil aviation in Europe up to the year 2000 was discussed. Transport policy, airport planning, and factors influencing services supplied by airlines were considered.

N84-19308# European Space Agency, Paris (France).
DEVELOPMENT POSSIBILITIES IN COMMERCIAL AIR TRANSPORT IN THE FEDERAL REPUBLIC OF GERMANY
H. G. NUESSER *In its* Develop. Possibilities and Restrictions in Air Transport p 9-46 Oct. 1983 Transl. into ENGLISH of conf. paper presented at Entwicklungsmoeglichkeiten u. Restriktionen im Luftverkehr Forum, rept. DFVLR-Mitt-81-19 West Germany, Aug. 1981 p 11-46 Conf. held in Cologne, 14 May 1981
Avail: NTIS HC A05/MF A01

Civil airline operations at West German airports from 1965 to 1978 were analyzed, and the situation in the 1990's was predicted. A growth in passenger rate of 4.9% per annum is expected, i.e., 75 million passengers, double the 1976 figure. Growth of demand

is met by increasing aircraft loading and by using larger aircraft, rather than by increasing operating frequency. Implications for airport planning are discussed. Author (ESA)

N84-19310# European Space Agency, Paris (France).
TRANSPORT INFRASTRUCTURE: IS PLANNING STILL ACHIEVABLE
U. CHRISTIANSEN *In its* Develop. Possibilities and Restrictions in Air Transport p 64-69 Oct. 1983 Transl. into ENGLISH of conf. paper presented at the Entwicklungsmoeglichkeiten u. Restriktionen im Luftverkehr Forum, rept. DFVLR-Mitt-81-19 West Germany, 1981 p 61-66 Conf. held in Cologne, 14 May 1981
Avail: NTIS HC A05/MF A01
Airport planning procedures in West Germany are discussed. Simplification of the procedures is advocated. Author (ESA)

N84-19311# European Space Agency, Paris (France).
THE SUPPLIER: CONSTRAINTS AND PROSPECTS
H. ST.SEIDENFUS *In its* Develop. Possibilities and Restrictions in Air Transport p 70-87 Oct. 1983 Transl. into ENGLISH of conf. paper presented at the Entwicklungsmoeglichkeiten u. Restriktionen im Luftverkehr Forum, rept. DFVLR-Mitt-81-19 West Germany, 1981 p 67-81 Conf. held in Cologne, 14 May 1981
Avail: NTIS HC A05/MF A01
Constraints imposed on civil airline operations by fuel prices, public reaction to environment effects, air traffic control procedures, airport infrastructures, and air traffic authorities are discussed. The economic advantages for airlines and nations of better air transport planning are pointed out. Author (ESA)

N84-19312# Air Force Packaging Evaluation Agency, Wright-Patterson AFB, Ohio.
REDESIGN OF CARGO MOBILITY CONTAINERS Final Report
20 Oct. 1983 23 p
(AD-A137396) Avail: NTIS HC A02/MF A01 CSCL 13D
Management and acquisition for a family of newly configured mobility containers was assigned to the Air Force Packaging Evaluation Agency (AFPEA). Program support, along with development funding for prototyping and testing, was provided by ASD/AFALD Productivity, Reliability, Availability and Maintainability (PRAM) office. The program objective, established by HQ USAF, was to implement an aggressive US Air Force Mobility Container Enhancement Program. As a result, new mobility containers were designed to maximize the cube usage of 463L pallets on C-141, C-130, KC-135, CRAF, and C-5 aircraft for MAC, TAC, SAC, NGB, and AFRES cargo mobility operations for their War Readiness Spares Kits (WRSK), Base Level Spares Support (BLSS), and Combat Follow-on Supply Support (CFOSS). Author (GRA)

N84-19313# Civil Aeronautics Board, Washington, D.C.
AIRPORT ACTIVITY STATISTICS OF CERTIFICATED ROUTE AIR CARRIERS Annual Report
31 Dec. 1982 368 p Prepared in cooperation with FAA, Washington, D.C.
(AD-A137418) Avail: NTIS HC A16/MF A01 CSCL 01B
This report furnishes airport activity of the Certificated Route Air Carriers. Included in the data are passenger enplanements, tons of enplaned freight, express, and mail. Both scheduled and non-scheduled service, and domestic and international operations are included. These data are shown by airport and carrier. Table 7 also included are departures by airport, carrier and type of operation, and type of aircraft. Author (GRA)

N84-19314# Boeing Military Airplane Development, Seattle, Wash.
ELECTROSTATIC SAFETY WITH EXPLOSION SUPPRESSANT FOAMS Final Report, Mar. 1980 - Sep. 1982
A. F. GRENICH and F. F. TOLLE Wright-Patterson AFB, Ohio AFWAL Mar. 1983 171 p
(Contract F33615-79-C-2093; AF PROJ. 3048)
(AD-A137503; AFWAL-TR-83-2015) Avail: NTIS HC A08/MF A01 CSCL 21B
Studies were made of the accumulation of electrostatic charges and subsequent discharges in aircraft fuel systems using explosion suppressant foams. The studies included a fuel system survey, small scale experiments, and fuel inlet nozzle designs. The results were used to develop guidelines for minimizing electrostatic hazards in aircraft fuel systems. Author (GRA)

N84-19315# Technische Hogeschool, Delft (Netherlands). Luchtvaart- en Ruimtevaarttechnik.
CENTRALIZED WARNING SYSTEMS FOR THE NEW GENERATION OF AIRLINERS [CENTRALLE WAARSCHUWINGSSYSTEMEN VOOR DE NIEUWE GENERATIE VERKEERSVLIEGTUIGEN]
M. L. WIJNHEIJMER Feb. 1983 52 p refs In NEPALI Submitted for publication
(VTH-LR-373) Avail: NTIS HC A04/MF A01
Design and operation of warning systems to be installed in aircraft are described. The ARINC 726 specification, and warning systems based on it are discussed. It is shown that within the same specification there is a broad domain for very different applications, with respect to components and operational aspects. The Boeing Engine Indicating and Crew Alerting System, the McDonnell Douglas engine monitoring and display system, Airbus Industry systems, and Fokker systems are presented. Author (ESA)

04

AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

A84-23248
DATA PROCESSING TECHNIQUES FOR IMAGING AIR TO AIR GUIDANCE SYSTEMS
P. CANTER and D. ALLEN (Hawker-Siddeley Dynamics Engineering, Ltd., Infra-Red Equipment Div., Hatfield, England) Aerospace Dynamics (ISSN 0263-2012), Oct. 1983, p. 10-17.
Attention is given to current trends in advanced imaging infrared homing leads and to the manner in which the acquisition and tracking process may take advantage of increases in on-board computing power and the steadily improving electronic packaging and design. It is noted that in the infrared wavebands there have been significant advances in detector technology owing to the chip revolution. These advances have made it possible to produce infrared sensors with a true imaging capability in a missile envelope. Advances in microprocessor technology have led to memory capacities suitable for data storage in usable volumes and to processors with sufficient speed to allow real-time applications at a low intelligence level. C.R.

A84-23260
PERFORMANCE ANALYSIS OF MONOPULSE RECEIVERS FOR SECONDARY SURVEILLANCE RADAR
G. JACOVITTI (Roma, Universita, Rome, Italy) IEEE Transactions on Aerospace and Electronic Systems (ISSN 0018-9251), vol. AES-19, Nov. 1983, p. 884-897. Sponsorship: Consiglio Nazionale delle Ricerche. refs
(Contract CNR-77,01090,91)

The performances of the existing monopulse receivers in secondary surveillance radar (SSR) applications are discussed in relation to the internal sources of error. The four principal types of monopulse receivers are described and classified according to their basic structure. The performance they offer in a Gaussian noise environment is then discussed. The main sources of internal errors are outlined and related to the operative conditions of the receivers. A detailed error analysis is then carried out using a general mathematical model of the receivers. The effects of the internal sources on the measurement accuracy are evaluated for each receiver, and the results are reported in both analytical form and comprehensive diagrams. C.R.

A84-23894
THE ERA OF ACTIVE RF MISSILES
D. PARKER and H. A. MAURER (Hughes Aircraft Co., Canoga Park, CA) Microwave Journal (ISSN 0026-2897), vol. 27, Feb. 1984, p. 24, 26, 28 (5ff).

It is pointed out that miniature radars for tactical missiles provide interesting challenges for microwave engineers. The present investigation is concerned with an active radar seeker for air intercept applications. The complexity of the device approaches that of a modern fire-control radar such as that of the F-15 fighter. The design of several microwave subsystems is discussed, taking into account radomes, seeker antennas, the RF processor, and miniature rotary joints. Future trends and technologies are also considered. It is found that the present era of active missile seekers for air intercept is mainly characterized by coherent transmission of diversified adaptive waveforms at high average power to compensate for small apertures. G.R.

A84-23896
TACTICAL USES OF IMAGING RADARS
S. A. HOVANESSIAN and J. C. NAVIAUX (Hughes Aircraft Co., El Segundo, CA) Microwave Journal (ISSN 0026-2897), vol. 27, Feb. 1984, p. 109, 110, 112 (7ff).

The radar-imaging mode provides fighter aircraft with the ability to carry out autonomous all-weather strike missions. In the 1950s, imaging devices were developed with sensitivities including also infrared regions from 0.8 to 15 microns. These passive devices detect thermal energy reflected or emitted from the terrain or man-made structures. The characteristics of imaging radars are discussed, taking into account real array and synthetic array. Attention is given to the use of the incremental Doppler shift between adjacent points on the ground, aspects of X-direction resolution, Y-direction resolution, the signal processing method, aspects of electronic signal processing, and the tactical applications of synthetic array radars. G.R.

A84-23900
A NEW GENERATION AIR DEFENSE RADAR
M. WITT and D. REEDER (Hughes Aircraft Co., Ground Systems, Group, Fullerton, CA) Microwave Journal (ISSN 0026-2897), vol. 27, Feb. 1984, p. 160, 162, 164.

Strike aircraft which can operate in the nap-of-the-earth regime may be able to avoid detection by conventional air-defense radar systems. In order to meet the threat posed by such aircraft to ground force concentrations, it is necessary to have a radar system expressly designed for the detection of aircraft approaching at such low altitudes. In addition to the needed performance, the required radar should be inexpensive enough for a deployment in adequate numbers, it should be reliable and robust for battlefield service, and it should be easily transportable. It was found that many of the desirable characteristics of the considered radar were already inherent in existing weapon-locating radar systems. Existing technology provided, therefore, an ideal starting point for the development of an affordable, battle-ready system to be called the Low Altitude Surveillance Radar (LASR). Details concerning LASR are discussed. G.R.

A84-23909#
A TERRAIN-AIDED NAVIGATION SYSTEM
H. CHEN (Changsha Institute of Technology, Changsha, People's Republic of China) Acta Aeronautica et Astronautica Sinica, vol. 4, Sept. 1983, p. 63-75. In Chinese, with abstract in English.

A terrain-aided navigation system which can correct the errors of inertial or other guidance systems and improve their navigational accuracy is presented. The system is composed of a Kalman filter, a radar altimeter, and a digitized terrain map. The predicted clearance is compared with the actual clearance as measured by the radar altimeter and the Kalman filter, and the error estimates are calculated using the terrain slope. These estimates are fed back to update the navigation system. Stochastic linearization technique is used to obtain the linearized measurement equation. Computer simulation results indicate that the location accuracy of the system is about ten meters for a typical hilly region. C.D.

A84-24749
PROBLEMS REGARDING SELECTIVE CALLING, GIVING PARTICULAR ATTENTION TO AIR-GROUND COMMUNICATION [PROBLEME DES SELEKTIVRUFES UNTER BESONDERER BERUECKSICHTIGUNG DES FLUGFUNKVERKEHRS]
G. WESTPHAL (Interflug Gesellschaft fuer Internationalen Flugverkehr mbH, Berlin, East Germany) Technisch-oekonomische Information der zivilen Luftfahrt (ISSN 0232-5012), vol. 19, no. 5, 1983, p. 147-151. In German. refs

The development of air-ground communication systems is discussed, taking into account problems arising with the increasing number of radio stations and the approaches found to overcome these problems. A calling system based on the utilization of audio frequencies was developed. In this system, the number of audio frequencies transmitted for a call and the number of possible audio frequencies determine the possibilities for distinguishing between calls and for providing an assurance against false calls. A compromise between the required engineering effort and system performance led to the introduction of the Selcal (selective calling) system for the international radio traffic of civil aviation. The Selcal system is discussed, taking into account also an extension of the original code system to satisfy requirements related to the development of air traffic. Attention is given to problems of signal transmission and the Doppler effect. G.R.

A84-25453* Analytical Mechanics Associates, Inc., Mountain View, Calif.
SHIP MOTION PATTERN DIRECTED VTOL LETDOWN GUIDANCE
A. V. PHATAK, M. S. KARMALI (Analytical Mechanics Associates, Inc., Mountain View, CA), and C. H. PAULK, JR. (NASA, Ames Research Center, Moffett Field, CA) IN: American Control Conference, San Francisco, CA, June 22-24, 1983, Proceedings. Volume 1 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 111-115.
(Contract NAS2-10288)

This paper examines ship motion pattern directed letdown guidance strategies for landing a VTOL aircraft onboard a small aviation ship under adverse environmental conditions. Off-line computer simulation of the shipboard landing task is utilized for assessing the relative merits of the proposed guidance schemes. A sum of seventy sinusoids representation is used to model the ship motion time histories. The touchdown performance of a nominal constant-rate-of-descent (CROD) letdown strategy serves as a benchmark for ranking the performance of the alternative letdown schemes. Author

A84-25462
DISTRIBUTED ESTIMATION IN THE MIT/LL DSN TESTBED
J. R. DELANEY, R. T. LACOSS, and P. E. GREEN (MIT, Lexington, MA) IN: American Control Conference, San Francisco, CA, June 22-24, 1983, Proceedings. Volume 1 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 305-311. DARPA-sponsored research. refs

Attention is given to the design features and performance characteristics of the acoustic tracking algorithms currently employed in the MIT Lincoln Laboratory's Distributed Sensor Networks test bed, in view of experimentation with both real and simulated data. Two algorithms have been developed for estimating target positions from histories of sensor measurements produced by two or more nodes. One algorithm has the advantage of introducing no greater delay into the target detection and tracking process than is forced by acoustic propagation. At one measurement time, it usually estimates the positions for different targets at different times, it usually estimates the positions for different targets at different times. The other algorithm forms estimates at each measurement time with a specified delay which is uniform for all targets. O.C.

A84-25508
AN APPROACH TO INTERCEPT ON-BOARD CALCULATIONS
H. J. KELLEY (Optimization, Inc., Blacksburg, VA) and K. WELL (Deutsche Forschungsund Versuchsanstalt fuer Luft- und Raumfahrt, Institut fuer Dynamik der Flugsysteme, Wessling, West Germany) IN: American Control Conference, San Francisco, CA, June 22-24, 1983, Proceedings. Volume 2 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 799, 800. Research supported by the Deutsche Forschungsund Versuchsanstalt fuer Luft- und Raumfahrt. refs

An approach to on-board real-time calculations for an aircraft intercept mission is described which employs Euler solutions for a point-mass vehicle model while using singular-perturbation concepts within a hierarchical trajectory-family structure. The scheme has two of the main advantages of singular perturbations: (1) representation of the controls as functions of the initial and terminal state values is not required, and (2) the dependence on initial values is simplified, avoiding multivariate fits. In the same way as singular perturbations, however, it breaks down as the termination of the dash is approached, and transition to some other control mode for end-game maneuvering is required. C.D.

N84-18182 Bundesanstalt fuer Flugsicherung, Frankfurt am Main (West Germany).
ACTIVITIES REPORT ON AIR TRAFFIC CONTROL IN THE FEDERAL REPUBLIC OF GERMANY Annual Report, 1982 [JAHRESBERICHT 1982]
1982 36 p In GERMAN
Avail: Issuing Activity

Measures for increased air traffic safety; air traffic incidents; navigation and radiophony techniques; information transmission techniques; radar technique; information technique; introduction electronic data handling systems; and television technical services are described. Author (ESA)

N84-18183*# Lockheed-California Co., Burbank.
DEVELOPMENT OF THE L-1011 FOUR-DIMENSIONAL FLIGHT MANAGEMENT SYSTEM Final Report, Sep. 1980 - Jul. 1982
H. P. LEE and M. F. LEFFLER Washington NASA Feb. 1984 147 p refs
(Contract NAS1-16199)
(NASA-CR-3700; NAS 1.26:3700; LR-30279) Avail: NTIS HC A07/MF A01 CSCL 01C

The development of 4-D guidance and control algorithms for the L-1011 Flight Management System is described. Four-D Flight Management is a concept by which an aircraft's flight is optimized along the 3-D path within the constraints of today's ATC environment, while its arrival time is controlled to fit into the air traffic flow without incurring or causing delays. The methods developed herein were designed to be compatible with the time-based en route metering techniques that were recently developed by the Dallas/Fort Worth and Denver Air Route Traffic Control Centers. The ensuing development of the 4-D guidance algorithms, the necessary control laws and the operational procedures are discussed. Results of computer simulation evaluation of the guidance algorithms and control laws are presented, along with a description of the software development procedures utilized. S.L.

N84-18185# Federal Aviation Administration, Washington, D.C. Office of Aviation Policy and Plans.
ESTABLISHMENT AND DISCONTINUANCE CRITERIA FOR PRECISION LANDING SYSTEMS
J. A. HAWKINS Sep. 1983 113 p
(AD-A135606; FAA-APO-83-10) Avail: NTIS HC A06/MF A01 CSCL 17G

This report describes the development of establishment criteria for the standard Microwave Landing System (MLS) with approach lights. The criteria were empirically derived from a benefit/cost analysis. The key elements of the criteria are expressed as a function of (a) annual instrument approaches (AIA's) by user category, (b) non-precision approach minima on the candidate runway, and (c) the probability of IFR weather at the airport. It is estimated that through 1985, the criteria will identify 218 new MLS candidates. Through 1995 the number of potential candidates is expected to reach 324. In addition to these systems, there will be approximately 768 systems in the ILS inventory that will be replaced by an MLS in accordance with guidelines developed in FAA's Microwave Landing System Transition Plan. This represents 1092 (768 + 324) or approximately 1100 systems by 1995. Benefits of an MLS vary widely depending on the proportionate use of the MLS runway, the distribution of instrument weather at the airport, aircraft operating costs, average number of passengers, and other factors. The MLS candidate runways, after first being qualified by regional offices on the basis of establishment criteria published in Airway Planning Standard Number One (APS-1), will then be evaluated by a benefit/cost analysis at FAA Headquarters. GRA

N84-19316 Heimatverband fuer den Kreis Steinburg, Itzenhoe (West Germany). Forschungsberichte.
AIRCRAFT OVER STEINBERG (WEST GERMANY) [LUFTFAHRZEUGE UEBER STEINBURG]
G. HOPPE 1982 15 p refs In GERMAN
(REPT-5/1982) Avail: Issuing Activity

A short historical review of the aviation over the Steinburg district from the airport Hungriger Wolf (Hohenlockstedt) is presented. It covers the period 1905-1980. Author (ESA)

N84-19317*# Theory and Applications Unlimited Corp., Los Gatos, Calif.
SIMULATION AND ANALYSIS OF DIFFERENTIAL GLOBAL POSITIONING SYSTEM FOR CIVIL HELICOPTER OPERATIONS
R. P. DENARO and A. R. CABAK Dec. 1983 141 p refs
(Contract NAS2-11339)
(NASA-CR-166534; NAS 1.26:166534) Avail: NTIS HC A07/MF A01 CSCL 17G

A Differential Global Positioning System (DGPS) computer simulation was developed, to provide a versatile tool for assessing DGPS referenced civil helicopter navigation. The civil helicopter community will probably be an early user of the GPS capability because of the unique mission requirements which include offshore exploration and low altitude transport into remote areas not currently served by ground based Navaids. The Monte Carlo simulation provided a sufficiently high fidelity dynamic motion and propagation environment to enable accurate comparisons of alternative differential GPS implementations and navigation filter tradeoffs. The analyst has provided the capability to adjust most aspects of the system, the helicopter flight profile, the receiver Kalman filter, and the signal propagation environment to assess differential GPS performance and parameter sensitivities. Preliminary analysis was conducted to evaluate alternative implementations of the differential navigation algorithm in both the position and measurement domain. Results are presented to

show that significant performance gains are achieved when compared with conventional GPS but that differences due to DGPS implementation techniques were small. System performance was relatively insensitive to the update rates of the error correction information. Author

N84-19319# Federal Aviation Administration, Washington, D.C. Systems Engineering Service.
AUTOMATED EN ROUTE AIR TRAFFIC CONTROL ALGORITHMIC SPECIFICATIONS. VOLUME 3: FLIGHT PLAN CONFLICT PROBE
W. P. NIEDRINGHAUS, I. FROLOW, J. C. CORBIN, A. H. GISCH, and N. J. TABER Sep. 1983 194 p
(AD-A136795; FAA-ES-83-6) Avail: NTIS HC A09/MF A01 CSCL 17G

This specification establishes design criteria for the Flight Plan Conflict Probe (FPCP), a part of the initial automation for the Advanced Automation System of the FAA's next generation air traffic control system. The algorithm provides data for a display to air traffic controllers whenever any two aircraft are predicted to approach each other within certain separation criteria in the horizontal and vertical dimensions. Such a pair of aircraft is called a conflict. Trajectory Estimation, another function of the Advanced Automation System, models the predicted position of each aircraft as a trajectory, consisting of points in (x,y,z,t) space and the line segments connecting them. Trajectories reflect both pilot intent (his approved flight plan) and current position (radar reports). FPCP automatically tests all trajectory pairs for conflicts. FPCP is designed to be compatible with current air traffic control procedures. It displays information early enough for controllers to resolve conflicts in a deliberate fashion. It alerts the the controller when prompt action is deemed necessary to resolve a conflict. GRA

N84-19320# Federal Aviation Administration, Washington, D.C. Systems Engineering Service.
AUTOMATED EN ROUTE AIR TRAFFIC CONTROL ALGORITHMIC SPECIFICATIONS. VOLUME 4: SECTOR WORKLOAD PROBE
W. P. NIEDRINGHAUS and A. H. GISCH Sep. 1983 122 p
(AD-A136796; FAA-ES-83-7; FAA-AES-320) Avail: NTIS HC A06/MF A01 CSCL 17G

This specification establishes design criteria for a Sector Workload Probe algorithm, which is part of the initial automation for the Advanced Automation System of the Federal Aviation Administration's Air Traffic Control System. This algorithm calculates measures related to workload. The algorithm takes into account a variety of measures. These measures include the following: average aircraft count; number of expected aircraft or airspace conflicts (as generated by two other advanced automation algorithms, Flight Plan Conflict Probe and Airspace Probe); a measure of actions which must be carried out by controllers; a density measure; and an overall measure. For every sector, each measure is projected for various time intervals of approximately 15 minutes up to about two hours in the future. An Area Supervisor or Area Manager may, at any time, request a display of the current and projected workload measures for a specified sector or set of sectors. Also, the Area Supervisor may monitor selected sector(s) to determine if certain measures exceed or fall below thresholds that he or she specifies. GRA

N84-19324# Federal Aviation Administration, Washington, D.C. Systems Engineering Service.
AUTOMATED EN ROUTE AIR TRAFFIC CONTROL ALGORITHMIC SPECIFICATIONS. VOLUME 2: AIRSPACE PROBE
J. A. KINGSBURY, N. S. MALTHOUSE, and K. B. SCHWAMB 31 Sep. 1983 138 p
(AD-A136850; DOT/FAA/ES-83/5) Avail: NTIS HC A07/MF A01 CSCL 09B

This algorithmic specification establishes the design criteria for four advanced automation software functions to be included in the initial software package of the Advanced Automation System (AAS). The need for each function is discussed within the context of the existing National Airspace System (NAS). A top-down definition of each function is provided with descriptions on increasingly more detailed levels. The final, most detailed description of each function identifies the data flows and transformations taking place within each function. This document consists of five volumes. Volume 2, airspace probe, contains a functional design for the use of trajectory data to predict penetrations of airspace, volumes from which the general flying public is normally restricted. 12 GRA

N84-19325# Federal Aviation Administration, Washington, D.C. Systems Engineering Service.
AUTOMATED EN ROUTE AIR TRAFFIC CONTROL ALGORITHMIC SPECIFICATIONS. VOLUME 5: DATA SPECIFICATION
L. FELLMAND and C. W. SCHUCK Sep. 1983 92 p
(AD-A136851; DOT/FAA/ES-83/8) Avail: NTIS HC A05/MF A01 CSCL 09B

This algorithmic specification establishes the design criteria for four advanced automation software functions to be included in the initial software package of the advanced automation system (AAS). The need for each function is discussed within the context of the existing national airspace system (NAS). A top-down definition of each function is provided with descriptions on increasingly more detailed levels. The final, most detailed description of each function identifies the data flows and transformations taking place within each function. This document consists of five volumes. Volume 5, Data Specification, contains the definitions of important data constructs used across all the algorithmic specifications. The data are accumulated in a modified relational data base. GRA

N84-19326# Federal Aviation Administration, Washington, D.C. Systems Engineering Service.
OPERATIONAL AND FUNCTIONAL DESCRIPTION OF THE AERA PACKAGES
A. W. LIPPS, W. J. SWEDISH, and B. C. ZIMMERMAN 11 Sep. 1983 120 p
(AD-A136852; DOT/FAA/ES-83/10) Avail: NTIS HC A06/MF A01 CSCL 09B

The AERA consists of a series of new or enhanced software functions which help the performance of en route air traffic control. Current planning calls for the AERA functions to be developed incrementally in a series of six separate packages. This document presents an overview of the AERA packages, with particular emphasis on the way the AERA functions interact with other ATC functions and with the controller. Functional descriptions of each package present the logical organization of the AERA functions, including the role of each function and the interfaces between functions. The operational descriptions discuss how the AERA functions will be used by the controller: when the function is invoked, what information is exchanged between the function and the controller, and how the controller is expected to respond. GRA

N84-19328# Federal Aviation Administration, Washington, D.C. Systems Engineering Service.
AUTOMATED EN ROUTE AIR TRAFFIC CONTROL ALGORITHMIC SPECIFICATIONS. VOLUME 1: TRAJECTORY ESTIMATION
J. A. KINGSBURG, D. A. POOL, S. K. GHOSH, N. S. MALTHOUSE, and G. J. ROUILLIER Sep. 1983 395 p
(AD-A137088; DOT/FAA/ES-83/4) Avail: NTIS HC A17/MF A01 CSCL 01E

This Algorithmic Specification establishes the design criteria for four advanced automation software functions to be included in the initial software package of the Advanced Automation System (AAS). The need for each function is discussed within the context of the existing National Airspace System (NAS). A top-down definition of each function is provided with descriptions on increasingly more detailed levels. The final, most detailed description of each function identifies the data flows and transformations taking place within each function. This document

consists of five volumes. Volume 1, Trajectory Estimation, contains a functional design for deriving a predicted four dimensional (space and time) path, or trajectory, for each participating aircraft. GRA

N84-19329# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Abt. Navigation und Flugbahnvermessung.
EVALUATION OF RADIO NAVIGATION SYSTEMS AND THEIR CONFIGURATION WITH RESPECT TO MINIMUM COST
W. GERLING Jul. 1983 41 p refs In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-847)
(DFVLR-FB-83-32; ESA-TT-847) Avail: NTIS HC A03/MF A01; DFVLR, Cologne DM 15,50

Different Rho/Theta and Rho/Rho navigation systems were compared to find minimum cost configurations of ground equipment, using methods that yield the minimum number of ground stations and their most favorable locations. The VHF Omnirange navigation/Distance measuring equipment (VOR/DME) systems are found to be applicable, but increased navigational efficiency standards are limited by the degree of accuracy of DME. The DME-supported azimuth systems (DAS) fulfil the same requirements at a substantially lower cost; DAS heavy-duty systems have only small advantages compared to basic DAS systems. The DME/DME systems represent an interesting alternative to DAS at similar cost, but limited accuracy limits the approachable navigational efficiency as for VOR/DME. Author (ESA)

05

AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

A84-23504#
A FATIGUE LIFE TRACKING PROGRAM FOR AN ALUMINUM WING
E. G. NICHOLS, C. E. DUMESNIL, and D. J. WHITE (Vought Corp., Dallas, TX) IN: Environmental degradation of engineering materials in aggressive environments . Blacksburg, VA, Virginia Polytechnic Institute and State University, 1983, p. 125-130.

A test and evaluation program of the fatigue critical location of the Navy A-7 Attack Aircraft wing was recently conducted. A test specimen was designed which represents the wing fatigue test failure location. Stress spectra were developed which represent variations in current Navy usage and flight condition. The corrosion fatigue characteristics of the wing skin material were evaluated by testing twenty-four specimens to failure in laboratory air, tapwater, and 3-1/2 percent saltwater solution environments. Test results were analyzed to determine the relative effect of spectra and environment variations on the specimen total fatigue life. The results of the tests and analysis were used to evaluate the existing method of tracking fatigue damage for the Navy A-7 fleet. Author

A84-23827#
AIRCRAFT OF THE WORLD - TRENDS OF THEIR DEVELOPMENT
H. KIMURA IN: Japan Titanium Society, Anniversary International Symposium, 30th, Kobe, Japan, November 15-18, 1982, Proceedings . Tokyo, Japan Titanium Society, 1983, p. 99-106. In Japanese, with abstract in English.

It is observed that, while aircraft development history witnessed drastic cruise speed increases between 1903 and 1965, when the world's aircraft speed record exceeded Mach 3, there has been a slackening of effort toward speed increases more recently and a greater preoccupation with such secondary, performance-enhancing aspects of design as electronic control. Attention is given to the performance gains obtained in recent years, with comparisons being drawn between the first commercial airliner design generation, represented by turbojet engines and the 707 aircraft, and the 747/second-generation turbofan combination. The comparative trends in L/D ratio and L/D x Mach number which make long distance supersonic cruise by the SR 71 reconnaissance aircraft possible are noted, together with the suggestive performance advantages of the National Aerospace Laboratory's Quiet STOL Research Aircraft. O.C.

A84-23905#
RELIABILITY ANALYSIS FOR PAIRED MAIN WING COMPONENTS
F. LIN and Y. HUANG (Northwestern Polytechnical University, Xian, People's Republic of China) Acta Aeronautica et Astronautica Sinica, vol. 4, Sept. 1983, p. 19-27. In Chinese, with abstract in English. refs

A method of statistical analysis for assessing the reliability of main wing components used pairwise in aircraft is presented. The statistical variability of structural fatigue life, the probability distribution of the size of cracks missed in inspection, the statistical distribution of applied service loads, the effects of crack propagation rate, and the fracture toughness of materials are taken into account. By considering the paired wing components as a cascade system, the probability distribution of initial crack sizes at the start of any inspection period is derived from the crack detection probability curve and crack propagation equation. Finally, two formulas for estimating failure probability in any inspection interval are derived, one applying to cracks forming during an interval and the other to cracks forming before the interval. A numerical example of failure probability in the main wing spars of a fighter aircraft is given. C.D.

A84-24104*# Gates Learjet Corp., Wichita, Kans.
AERODYNAMIC DESIGN OPTIMIZATION TRIM ANALYSIS OF CANARD CONVENTIONAL CONFIGURATIONS
M. W. KEITH (Gates Learjet Corp., Wichita, KS) and B. P. SELBERG (Missouri-Rolla, University, Rolla, MO) Journal of Aircraft (ISSN 0021-8669), vol. 21, March 1984, p. 183-192. refs
(Contract NAG1-26)

Previously cited in issue 05, p. 594, Accession no. A83-16490

A84-24107*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AIRFOIL SHAPE AND THICKNESS EFFECTS ON TRANSONIC AIRLOADS AND FLUTTER
S. R. BLAND and J. W. EDWARDS (NASA, Langley Research Center, Unsteady Aerodynamics Branch, Hampton, VA) (Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers. Part 2, p. 490-497) Journal of Aircraft (ISSN 0021-8669), vol. 21, March 1984, p. 209-217. refs

Previously cited in issue 12, p. 1702, Accession no. A83-29860

A84-24110#
ANALYTIC EXTRAPOLATION TO FULL-SCALE AIRCRAFT DYNAMICS
L. E. ERICSSON and J. P. REDING (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA) Journal of Aircraft (ISSN 0021-8669), vol. 21, March 1984, p. 222-224. refs

A study of the scaling problem in the dynamic testing of aircraft-like configurations has revealed that full scale unsteady aerodynamics cannot be simulated in dynamic tests at subscale Reynolds numbers; nor can they be obtained by purely theoretical means, when the boundary layer transition and flow separation are involved. Attention is presently given to the means by which full scale vehicle dynamics can be simulated through an 'analytic extrapolation' method, in which analytic relationships are established between dynamic and static aerodynamic characteristics induced by viscous flow effects. O.C.

A84-24180#
LOAD-DEPENDING DEFORMATIONS OF WINDTUNNEL MODELS
H. P. FRANZ, G. KRENZ, and J. KOTSCHOTE (Messerschmitt-Boelkow-Blohm GmbH, Bremen, West Germany) IN: Aerodynamic Testing Conference, 13th, San Diego, CA, March 5-7, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 38-45. refs
(AIAA PAPER 84-0589)

The development of civil aircraft requires an optimized aerodynamic design, which is mainly based on reliable wind-tunnel tests. The accuracy requirements in test result data have increased considerably. The aeroelastic deformations of aircraft and model became absolutely necessary to investigate in particular. An experimental method to determine the aeroelastic model deformations under wind tunnel loads by a static calibration out of the wind tunnel has been developed. The stiffness matrix of the model wing has been determined by application of single point-centered loads. In correlation with the aerodynamic wing loads the actual deformation of the model wing can be calculated, the expected deformation at any defined load case can be predicted and for a selected design point taken into account with the production of the model wing. Author

A84-24195*# Texas A&M Univ., College Station.
PERFORMANCE DEGRADATION OF A MODEL HELICOPTER MAIN ROTOR IN HOVER AND FORWARD FLIGHT WITH A GENERIC ICE SHAPE
K. D. KORKAN, E. J. CROSS, JR. (Texas A & M University, College Station, TX), and T. L. MILLER IN: Aerodynamic Testing Conference, 13th, San Diego, CA, March 5-7, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 187-200. refs
(Contract NAG3-242)
(AIAA PAPER 84-0609)

A model helicopter has been used to collect test data and provide an experimental means of studying helicopter performance in a subsonic wind tunnel. A simulated generic ice shape was attached to the rotor blades and performance data were obtained for both hover and forward flights. Significant degradation in helicopter performance with respect to torque and thrust coefficient was observed; the rotor tip region was especially sensitive. Two-dimensional wind tunnel tests were conducted over a Reynolds number range 0.7-3 x 10 to the 6th in order to investigate the effect of Reynolds number on the aerodynamic performance of the airfoil in both clean and iced configurations. Only minimal dependence of the aerodynamic data on Reynolds number was observed. C.D.

A84-24197#
THRUST AND DRAG OF AIRCRAFT - PREDICTION AND VERIFICATION
E. E. COVERT (MIT, Cambridge, MA) IN: Aerodynamic Testing Conference, 13th, San Diego, CA, March 5-7, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 213-223.
(AIAA PAPER 84-0611)

A brief summary of the state of the art of prediction, measurement and test verification of measurement of thrust and drag is presented. The discussion includes the rationale for a thrust and drag accounting procedure as well as problems and results of the estimation of thrust and drag, and verification of the estimates. Author

A84-24569
SHIELDING OF PROP-FAN CABIN NOISE BY THE FUSELAGE BOUNDARY LAYER
D. B. HANSON (United Technologies Corp., Hamilton Standard Div., Windsor Locks, CT) Journal of Sound and Vibration (ISSN 0022-460X), vol. 92, Feb. 22, 1984, p. 591-598. refs

Recent flight tests of a Prop-Fan (advanced technology turboprop) model mounted on a business aircraft revealed noise levels on the fuselage surface considerably lower than was expected from theoretical calculations and other test experience. In this paper the role of the fuselage boundary layer in shielding the surface from noise via classical refraction effects is examined. In order to study the physical phenomenon with minimum mathematical complexity, the boundary layer is modeled by concentrating its shear in an infinitesimally thin layer displaced an effective boundary layer thickness from a rigid wall. Incident energy is assumed to arrive in plane waves. For the Prop-Fan model at its design cruise Mach number of 0.8, the theory indicates a strong shielding effect. The shielding diminishes at lower flight Mach number and for larger sound wavelengths. At full scale, the shielding effects will be less than in model scale because the wavelength of the dominant noise is larger relative to the fuselage boundary layer thickness. Author

A84-24996#
OPTIMAL TRAJECTORIES FOR MAXIMUM ENDURANCE GLIDING IN A HORIZONTAL PLANE
N. X. VINH (Michigan, University, Ann Arbor, MI), C.-Y. YANG, and J.-S. CHERN (Chung Shan Institute of Science and Technology, Lungtan, Republic of China) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 7, Mar.-Apr. 1984, p. 246-248. refs

Previously cited in issue 21, p. 3620, Accession no. A81-44564

A84-25176#
EXPERIMENTAL STUDY OF HINGE MOMENT IN THE SUBSONIC AND TRANSONIC SPEED RANGE [EKSPERYMENTALNE BADANIA MOMENTU ZAWIASOWEGO W ZAKRESIE POD- I PRZYDZWIEKOWYCH PREDKOSCI]
A. KRZYSIAK Instytut Lotnictwa, Prace (ISSN 0509-6669), no. 94, 1983, p. 3-22. In Polish. refs

The paper reports the measurement of the hinge moment and the visualization of the flow past a trapezoidal tailplane with a small sweep angle and a symmetric profile over the entire span. Wind tunnel tests were conducted in the Mach number range of 0.3-0.94; the coefficient of the hinge moment was determined as a function of the attack angle of the tailplane and the displacement angles of the elevator; the hinge moment was analyzed for three different elevator balances, K = 25, 27.86, and 32 percent. B.J.

A84-25194
MEASURED AERODYNAMIC FORCES ON THREE TYPICAL HELICOPTER TAIL BOOM CROSS SECTIONS
J. C. WILSON and H. L. KELLEY (U.S. Army, Structures Laboratory, Hampton, VA) American Helicopter Society, Journal (ISSN 0002-8711), vol. 28, Oct. 1983, p. 68-71. refs

UH-1, UH-60, and AH-64 helicopter tail boom cross sections have been wind tunnel tested to determine aerodynamic forces, as affected by flow incidence angles from -45 deg to 90 deg and dynamic pressure from 2.5 to 45 psf. It is found that sideforce loading can be more significant than vertical drag. Flow incidence angles induced by rotor wake swirl and sideward flight result in high side loads on the booms, and spoilers offer a means for the reduction of high side loads on a tail boom under some flight conditions. O.C.

A84-25485* Analytical Mechanics Associates, Inc., Mountain View, Calif.
GENERATION AND EVOLUATION OF NEAR-OPTIMUM VERTICAL FLIGHT PROFILES
J. A. SORENSEN (Analytical Mechanics Associates, Inc., Mountain View, CA) IN: American Control Conference, San Francisco, CA, June 22-24, 1983, Proceedings. Volume 2 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 513-518. refs
(Contract NAS1-15497)

The overall objectives of this research effort have been to develop and evaluate algorithms and flight management concepts for minimization of fuel or direct operating costs. These concepts are to be used for flight planning or for on-board computation and steering of turbojet transport aircraft in the vertical path. Within this research context, a computer program, called OPTIM, has

been developed to use these algorithms to generate near-optimum vertical reference profiles. OPTIM contains control options to examine effects of various flight constraints on cost performance. A companion program, called TRAGEN, was developed to simulate an aircraft flying along a given vertical reference profile. TRAGEN is used to verify OPTIM's output , to examine the effects of parameter value uncertainty (such as prevailing wind), and to compare cost performance of profiles generated by different techniques. This paper describes OPTIM and TRAGEN and presents examples of the programs utility. Author

A84-25486* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ALTITUDE/PATH-ANGLE TRANSITIONS IN FUEL-OPTIMAL PROBLEMS FOR TRANSPORT AIRCRAFT
C. GRACEY and D. B. PRICE (NASA, Langley Research Center, Flight Dynamics and Control Div., Hampton, VA) IN: American Control Conference, San Francisco, CA, June 22-24, 1983, Proceedings. Volume 2 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 519-525. refs

Altitude/path angle transitions to fuel-optimal, energy climb and descent paths are examined for subsonic transport aircraft. These transitions are termed boundary layers in singular perturbation theory, the framework used herein to simplify solutions to the state-Euler system. The energy climb and descent paths provide equilibrium or stationary points for the boundary layer system, and thus for moderate transitions, presumed valid for the class of aircraft considered, the boundary layer system may be linearized. This simplification allows derivation of an explicit solution to the two-point boundary-value, boundary layer problem and, as a consequence, yields a nearly optimal control law, in feedback form, for the transitions. Numerical simulation results using the feedback control law are presented for a Boeing 737 airframe (NASA-ATOPS Vehicle) employing twin JT8D-7-7A engines. Author

A84-25488* Virginia Polytechnic Inst. and State Univ., Blacksburg.
ON-BOARD NEAR-OPTIMAL CLIMB-DASH ENERGY MANAGEMENT
A. R. WESTON, E. M. CLIFF, and H. J. KELLEY (Virginia Polytechnic Institute and State University, Blacksburg, VA) IN: American Control Conference, San Francisco, CA, June 22-24, 1983, Proceedings. Volume 2 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 534-539. refs
(Contract NAG1-203)

On-board real time flight control is studied in order to develop algorithms which are simple enough to be used in practice, for a variety of missions involving three-dimensional flight. The intercept mission in symmetric flight is emphasized. Extensive computation is required on the ground prior to the mission but the ensuing on-board exploitation is extremely simple. The scheme takes advantage of the boundary layer structure common in singular perturbations, arising with the multiple time scales appropriate to aircraft dynamics. Energy modelling of aircraft is used as the starting point for the analysis. In the symmetric case, a nominal path is generated which fairs into the dash or cruise state. Previously announced in STAR as N84-16116 S.L.

A84-25506
4-D AIRCRAFT FLIGHT PATH MANAGEMENT IN REAL TIME
A. CHAKRAVARTY (Boeing Commercial Airplane Co., Seattle, WA) and J. VAGNERS (Washington, University, Seattle, WA) IN: American Control Conference, San Francisco, CA, June 22-24, 1983, Proceedings. Volume 2 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 794, 795.

The four-dimensional aircraft flight path management problem in the vertical plane is analyzed using a 'Fibonacci search' parameter optimization method. The aircraft investigated is a typical commercial jet transport; only the last segment of the flight trajectory is considered. The optimal trajectories for a maximum range cruise problem with no delay and with a delay of 10 minutes are shown. Trajectories are also depicted for a five-minute delay and different wind conditions. The change in cruise altitude is the most dramatic for tailwind, and the descents are the most shallow. Consequently, the fuel spent for the same amount of delay is maximum for tailwind and minimum for headwind. C.D.

A84-25507* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A STUDY OF ALTITUDE AND FLIGHT PATH ANGLE DYNAMICS FOR A SINGULARLY PERTURBED FUEL OPTIMIZATION PROBLEM
D. B. PRICE and C. GRACEY (NASA, Langley Research Center, Flight Dynamics and Control Div., Hampton, VA) IN: American Control Conference, San Francisco, CA, June 22-24, 1983, Proceedings. Volume 2 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 796-798. refs

This short paper will demonstrate that the separation of altitude and flight path angle dynamics using singular perturbation techniques for a transport fuel optimization problem results in an unacceptable oscillation in altitude. A technique for damping this oscillation by adding a penalty term to the cost function for the optimization problem will be discussed. This technique will be compared with a different approach that linearizes the altitude and flight path angle boundary layers. Author

A84-25730#
COMPARISON OF FLIGHT AND WIND TUNNEL DATA ON THE DORNIER TST CONFIGURATION
C. J. SPURLIN (Calspan Field Services, Inc., Arnold Air Force Station, TN) and H. LUECK (Dornier GmbH, Friedrichshafen, West Germany) American Institute of Aeronautics and Astronautics, Aerodynamic Testing Conference, 13th, San Diego, CA, Mar. 5-7, 1984. 9 p. refs
(AIAA PAPER 84-0612)

Aerodynamic data obtained in AEDC Tunnels 16T and 4T and ONERA Tunnel S2 (Modane) with a 1/10-scale Dornier TST model are compared with data obtained during full-scale flight tests of the TST experimental aircraft. Mach number varied from 0.6 to 0.91 and angle of attack from -3 to 10 deg. Wing surface pressure distributions obtained at identical locations in flight and in Tunnels 16T, S2MA, and 4T along with overall force and moment data are compared and wall interference effects are inferred. The model-to-tunnel blockage ratio was 0.16 percent in Tunnel 16T, 1.2 percent in Tunnel S2 (Modane), and 2.6 percent in Tunnel 4T. Reynolds number effects were shown to be small and ruled out as a source of the data differences. The force data comparisons showed differences which varied with model blockage ratio consistent with expected variations from a wind tunnel with test section walls too closed; whereas, the pressure data from the wing upper surface showed the opposite effect. However, the pressure data from the wing lower surface did show differences which varied with model blockage consistent with the force data differences. Author

A84-25731#
EFFECTS OF INLET SPILLAGE ON STORE CARRIAGE LOADS AND LAUNCH TRAJECTORIES
R. B. SORRELLS, M. C. TOWNE (USAF, Arnold Engineering Development Center, Arnold Air Force Station, TN), C. F. ANDERSON, and R. H. TOLBERT (Calspan Field Services, Inc., Arnold Engineering Development Center, Arnold Air Force Station, TN) American Institute of Aeronautics and Astronautics, Aerodynamic Testing Conference, 13th, San Diego, CA, Mar. 5-7, 1984. 4 p.
(AIAA PAPER 84-0615)

Aircraft/store compatibility wind tunnel tests have been traditionally conducted without regard for the particular throttle-dependent inlet spillage condition which is simulated in the aircraft model. Tests were conducted in the AEDC 4-ft transonic wind tunnel (Aerodynamic Wind Tunnel (4T)) on a twin-engined, horizontal-ramped inlet fighter aircraft configured with air-to-air missiles and with provisions for simulating both maximum and cruise inlet spillage. The results indicate that for the missile carried nearest to the inlet the carriage loads were as high as 100 percent larger for the maximum spillage condition than for the cruise spillage

condition. Jettison trajectories calculated for this missile indicate that the ejection forces dominate the early portion of the trajectory, and no significant difference was seen between maximum and cruise spillage conditions. Author

A84-26319
ACAP - DAWN OF A NEW ERA
M. GAINES Flight International (ISSN 0015-3710), vol. 125, March 3, 1984, p. 575-577.

Attention is given to the technology development achievements to date of the U.S. Army's Advanced Composite Airframe Program (ACAP), which has already reached the final assembly stage. The tooling-demonstration, static testing and flight testing prototypes under preparation by ACAP's two competing manufacturers must demonstrate that no area of the composite primary helicopter airframe structure is vulnerable to 12.7 mm armor-piercing incendiary rounds, and display minimal vulnerability to 23 mm high explosive incendiary tracer rounds. In addition, the composite airframes's radar signature reduction must equal a perceived signal attenuation of at least 15 dB. The composite materials employed by the ACAP helicopter airframes include carbon fiber- and Kevlar-reinforced epoxy. The development of novel laminate composite layup procedures is noted. O.C.

A84-26320
ROTORS REVOLUTIONISED
G. WARWICK Flight International (ISSN 0015-3710), vol. 125, March 3, 1984, p. 582, 583.

An assessment is given of the extent to which recent aerodynamic refinements and mechanical design simplifications have overcome such classical disadvantages of rotary wing aircraft as limited speed performance, high vibration levels, and costly maintenance requirements. Attention is given to the S-72 rotor system research aircraft, which may be flown in several (pure helicopter, winged helicopter, and turbofan-assisted helicopter) configurations. The S-72 will be used later in this decade to test advanced, bearingless rotor designs in which the flap, lead/lag, and pitch hinges are replaced by a composite flexbeam sufficiently stiff to resist flapping and lead/lag forces, yet flexible enough to accommodate blade pitch change through twisting. Performance goals for these rotors include higher cruise and dash speeds and increased rotor L/D. Also noted are helicopter all-composite rotors which may be fully articulated, and use flap and pitch elastomeric bearings close to the hub and combined lead/lag and blade-fold bearings outboard. O.C.

N84-18189*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
EFFECTS OF MOTION BASE AND G-SEAT CUEING OF SIMULATOR PILOT PERFORMANCE
B. R. ASHWORTH, B. T. MCKISSICK, and R. V. PARRISH Mar. 1984 26 p refs
(NASA-TP-2247; L-15559; NAS 1.60:2247) Avail: NTIS HC A03/MF A01 CSCL 05I

In order to measure and analyze the effects of a motion plus g-seat cueing system, a manned-flight-simulation experiment was conducted utilizing a pursuit tracking task and an F-16 simulation model in the NASA Langley visual/motion simulator. This experiment provided the information necessary to determine whether motion and g-seat cues have an additive effect on the performance of this task. With respect to the lateral tracking error and roll-control stick force, the answer is affirmative. It is shown that presenting the two cues simultaneously caused significant reductions in lateral tracking error and that using the g-seat and motion base separately provided essentially equal reductions in the pilot's lateral tracking error. A.R.H.

N84-18190*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
HOVER TEST OF A FULL-SCALE HINGELESS HELICOPTER ROTOR: AEROELASTIC STABILITY, PERFORMANCE AND LOADS DATA
R. L. PETERSON and W. WARMBRODT Jan. 1984 52 p refs
(NASA-TM-85892; A-9573; NAS 1.15:85892) Avail: NTIS HC A04/MF A01 CSCL 01C

A hover test of a full-scale, hingeless rotor system was conducted in the NASA Ames 40- by 80-foot wind tunnel. The rotor was tested on the Ames rotor test apparatus. Rotor aeroelastic stability, performance, and loads at various rotational speeds and thrust coefficients were investigated. The primary objective was to determine the inplane stability characteristics of the rotor system. Rotor inplane damping data were obtained for operation between 350 and 425 rpm (design speed), and for thurst coefficients between 0.0 and 0.12. The rotor was stable for all conditions tested. At constant rotor rotational speed, a minimum inplane dampling level was obtained at a thrust coefficient approximately = 0.02. At constant rotor lift, a minimum in rotor inplane damping was measured at 400 rpm. Author

N84-18191# Naval Postgraduate School, Monterey, Calif.
COMPUTER PROGRAMS FOR HELICOPTER HIGH SPEED FLIGHT ANALYSIS M.S. Thesis
W. F. CARMONA Sep. 1983 139 p
(AD-A136376) Avail: NTIS HC A07/MF A01 CSCL 01C

This report gives to the user of the HP41-CV handheld programmable calculator or the IBM 3033 computer a blade element method for calculating the total power required in forward, straight and level high-speed flight for an isolated rotor. The computer programs consist of a main program which calculates the necessary dynamic parameters of the main rotor and several subroutines which calculate power required as well as maximum forward velocity, stall onset velocity, and velocity for best endurance. GRA

N84-18193# Canyon Research Group, Inc., Westlake Village, Calif.
DEVELOPMENT OF SPEECH INPUT/OUTPUT INTERFACES FOR TACTICAL AIRCRAFT Final Report, Dec. 1981 - Jul. 1983
J. C. COTTON, M. E. MCCAULEY, R. A. NORTH, and M. I. STRIEB Wright-Patterson AFB, Ohio AFWAL Jul. 1983 185 p
(Contract F33615-81-C-3622; AF PROJ. 2403)
(AD-A136485; AFWAL-TR-83-3073) Avail: NTIS HC A09/MF A01 CSCL 01C

This report covers the methods and the results in the selection of tasks for speech input/output (I/O) in the fighter cockpit of the future. A description is given of the candidate speech tasks derived from interviews with experienced F-16 pilots, an analysis of a composite air-to-ground scenario, and a questionnaire survey of F-16 pilots at Nellis AFB. Author (GRA)

N84-18194# Tactical Air Command, Langley AFB, Va.
AQM-81A FIREBOLT
21 Oct. 1983 5 p
(AD-A135895) Avail: NTIS HC A02/MF A01 CSCL 01C

Supersonic subscale aerial targets are required for employment in weapons system development, test and evaluation, and training to simulate high performance aircraft and missiles. As a result of extensive studies by the Air Force and Navy and successful completion of advanced development, the AQM-81A Firebolt has been selected at the most cost effective solution to satisfy projected high altitude supersonic requirements. The AQM-81A Firebolt vehicle is 216 inches long and 13 inches in diameter. The propulsion system uses a solid propellant with a liquid oxidizer catalyst. The vehicle contains a parachute recovery system to allow midair retrieval as the primary recovery procedure and a flotation system to allow water recovery. A Programmable Radar Augmentation System (PRAS) provides in the forward hemisphere (+10 to -60 sq m degrees in elevation). The Scalar Scoring System (SSS)

provides missiles miss distance information throughout 90 percent of the scoring volume described by a 150-foot sphere centered on the target. The purpose of this project is to support AFOTEC in the IOT&E of the AQM-81A Firebolt system. The purpose of the AQM-81A IOT&E is to evaluate the military utility of the Firebolt system in simulating representative threat targets for weapon system evaluation and training. GRA

N84-18195# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Systems and Logistics.
A COST PREDICTION MODEL FOR ELECTRONIC SYSTEMS FLIGHT TEST COSTS M.S. Thesis
T. J. DUPRE Sep. 1983 92 p
(AD-A135598; AFIT-LSSR-108-83) Avail: NTIS HC A05/MF A01 CSCL 14A

Emphasis on improving service cost estimates continues to receive high Department of Defense priority. The purpose of this study was to develop a cost estimating model that would predict flight test costs for electronic systems during early phases of a program's development. It was found that a significant cost estimating relationship (CER) exists between costs and the characteristics of the flight test design. Using a data base collected from the 3246th Test Wing, Eglin Air Force Base, a CER was developed using a multiple regression process. Statistical and logical tests were performed in order to determine the validity of the model. The CER developed may be used as an estimating tool for future budget preparations for flight testing electronic systems. Author (GRA)

N84-18196*# Boeing Vertol Co., Philadelphia, Pa.
INVESTIGATION OF THE EFFECT OF BLADE SWEEP ON ROTOR VIBRATORY LOADS
F. J. TARZANIN, JR. and R. R. VLAMINCK Oct. 1983 134 p
(Contract NAS2-11151)
(NASA-CR-166526; NAS 1.26:166526; AD-A135603) Avail: NTIS HC A07/MF A01 CSCL 01C

The effect of helicopter rotor blade planform sweep on rotor vibratory hub, blade, and control system loads has been analytically investigated. The importance of sweep angle, sweep initiation radius, flap bending stiffness and torsion bending stiffness is discussed. The mechanism by which sweep influences the vibratory hub loads is investigated. Author (GRA)

N84-18197# Naval Postgraduate School, Monterey, Calif.
COMPUTER PROGRAM FOR PRELIMINARY HELICOPTER DESIGN M.S. Thesis
M. W. ROGERS Sep. 1983 126 p
(AD-A136026) Avail: NTIS HC A07/MF A01 CSCL 01C

This report gives the operator of the Hewlett-Packard (HP-41) handheld calculator the ability to quickly and accurately determine the power requirements of a helicopter in the preliminary design phase. These power requirements are computed for three landing gear configurations: skid, fixed wheel, and retractable wheel. By comparing the power required for each configuration, the user can determine the optimum landing gear for the design. Author (GRA)

N84-18198# Army Cold Regions Research and Engineering Lab., Hanover, N. H. Snow and Ice Branch.
MECHANICAL ICE RELEASE PROCESSES. PART 1: SELF-SHEDDING FROM HIGH-SPEED ROTORS
K. ITAGAKI Oct. 1983 14 p
(Contract DA PROJ. 4A1-61102-AT-24)
(AD-A135369; CRREL-83-26) Avail: NTIS HC A02/MF A01 CSCL 08L

Ice accreted on high-speed rotors operating in supercooled fog can be thrown off by centrifugal force, creating severe unbalance and dangerous projectiles. A simple force balance analysis indicates that the strength of accreted ice and its adhesive strength can be obtained by measuring the thickness of the accretion, the location of the separation, the rotor speed, and the density. Such an analysis was applied to field and laboratory observations of self-shedding events. The results agree reasonably well with other observations. Author (GRA)

N84-18199# California Univ., Livermore. Lawrence Livermore Lab. Electromagnetic Sciences Group.
ASSESSMENT METHODOLOGY FOR THE A-7E: SCALE MODEL COUPLING EXPERIMENTS
E. J. BOGDAN and D. WYTH May 1983 445 p refs
(Contract W-7405-ENG-48)
(DE84-003139; UCID-19850) Avail: NTIS HC A19/MF A01

Transient electromagnetic measurements were performed on a scale model of the A-7E aircraft as part of the FAANTAEL program concerned with the development of a methodology for assessing navy aircraft. A 1:10 scale model of the A-7E was developed and tested in configurations which resemble those used in the full scale aircraft EMP simulation tests at the Air Force Weapons features including a conductive exterior surface, wings that can be folded, and internal compartments. External coupling measurements included horizontal and vertical polarization with wings up and wings down for different modes such as take-off, on ground, and flight. Internal coupling measurements included currents on model cables such as conduit nose to tail and left avionics bay to horizontal tail. The scale model measurement results were extrapolated to compare with those obtained from the full scale tests. The external measurements compare favorably (factors of two for peak amplitudes). Internal measurements show greater variation and are consistently higher in peak amplitudes by factors of two to eight. DOE

N84-18200# National Aerospace Lab., Amsterdam (Netherlands). Flight Div.
TRENDING OF CRUISE DRAG
J. P. K. VLEGHERT 10 Aug. 1982 13 p
(NLR-TR-82078-U) Avail: NTIS HC A02/MF A01

A method to trend cruise performance to an accuracy of + or - 1 % is decribed. The method redefines the so-called stable frame used for cruise performance calculation, but uses standard AIDS practices. It is usable while altitude and air speed vary slightly, and the effect of autothrottle action can be included. Measures necessary to account for atmospheric discrepancies which influence the trend figures are indicated. Author (ESA)

N84-19333*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AN ASSESSMENT OF THE CAPABILITY TO CALCULATE TILTING PROP-ROTOR AIRCRAFT PERFORMANCE, LOADS AND STABILITY
W. JOHNSON Mar. 1984 25 p refs
(NASA-TP-2291; A-9411; NAS 1.60:2291) Avail: NTIS HC A02/MF A01 CSCL 01C

Calculated performance, loads, and stability of the XV-15 tilt rotor research aircraft are compared with wind tunnel and flight measurements, to define the level of the current analytical capability for tilting prop rotor aircraft, and to define the requirements for additional experimental data and further analysis development. The correlation between calculated and measured behavior is generally good, although there are some significant discrepancies. Based on this correlation, the analysis is assessed overall as being adequate for the design, evaluation, and testing of tilting prop rotor aircraft. A general assessment of the state of the art of tilt rotor predictive capability is given. Specific areas are identified where improvements in the capability to calculate performance, loads, and stability are desirable. Requirements for more accurate and detailed data which support the development of improved analytical models are identified as well. Author

N84-19334*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
IN-FLIGHT ACOUSTIC TESTING TECHNIQUES USING THE YO-3A ACOUSTIC RESEARCH AIRCRAFT
J. L. CROSS and M. E. WATTS Feb. 1984 11 p refs
Document previously announced as A84-12342
(NASA-TM-85895; A-9660; NAS 1.15:85895) Avail: NTIS HC A02/MF A01

This report discusses the flight testing techniques and equipment employed during air-to-air acoustic testing of helicopters at Ames Research Center. The in flight measurement technique used enables acoustic data to be obtained without the limitations of anechoic chambers or the multitude of variables encountered in ground based flyover testing. The air-to-air testing is made possible by the NASA YO-3A Acoustic Research Aircraft. This 'Quiet Aircraft' is an acoustically instrumented version of a quiet observation aircraft manufactured for the military. To date, tests with the following aircraft have been conducted: YO-3A background noise; Hughes 500D; Hughes AH-64; Bell AH-1S; Bell AH-1G. Several system upgrades are being designed and implemented to improve the quality of data. This report will discuss not only the equipment involved and aircraft tested, but also the techniques used in these tests. In particular, formation flying position locations, and the test matrices will be discussed. Examples of data taken will also be presented. Author

N84-19335*# National Aeronautics and Space Administration, Washington, D. C.
NATIONAL AEROSPACE LABORATORY NEWS (JAPAN)
J. TAKEDA Aug. 1982 18 p Transl. into ENGLISH of Kogiken Nyusu (Japan), no. 275, Mar. 1982 8 p Transl. by Scientific Translation Service, Santa Barbara, Calif. Original doc. prep. by National Aerospace Lab., Tokyo
(Contract NASW-3542)
(NASA-TM-76962; NAS 1.15:76962) Avail: NTIS HC A02/MF A01 CSCL 01C

Tests carried out in November 1981 on the stationary flap of STOL test planes at Kakuda Labs are described. Acoustic pressure, outer plate temperature of the fore flap, and acceleration, strain, and temperature of the outer plate of the main flap were measured. High load turbine inlet distortion experiments were also performed. Results of these experiments are discussed. Author

N84-19336# Naval Intelligence Support Center, Washington, D. C. Translation Div.
APPLICATIONS OF COMPOSITE MATERIALS IN HELICOPTER CONSTRUCTION
G. BEZIAC 21 Nov. 1983 41 p Transl. into ENGLISH from Aeronaut. Astronaut. (France), no. 98, 1983 p 21-40
(AD-A136678; NISC-TRANS-7224) Avail: NTIS HC A03/MF A01 CSCL 01C

The helicopter is a much more complex machine and more difficult to construct than a similar size aircraft owing to several factors: (1) mechanical transmission elements which must provide a very great reduction of the main engine speed; (2) presence of an antitorque rotor placed in the rear of the craft at the end of a long and relatively flexible tail boom; (3) presence of dynamic vibrations from the rotors of a level which is higher as the speed is greater, requiring the dimensioning of a number of transmission, control, and structural elements for fatigue as well as an optimization of the dynamics of the rotating assemblies and of the vibrational responses in the cockpit and the cabin in the presence of vibration absorbers either at the rotor or between the rotor and the fuselage or in the cabin itself; and (4) the need for a given total weight to seek the minimal empty weight so that the machine can perform vertical flight with the best economy of operation possible. The efforts conducted for many decades by designers of helicopters and turboshaft engines and has made a steady improvement in the operational capabilities in both the military and the civilian domain and a reduction in production and operating costs. Author

N84-19338# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
SUBOPTIMAL MISSILE EVASION THROUGH A SENSITIVITY ANALYSIS OF PROPORTIONAL GUIDANCE TO TARGET EVASION MANEUVERS M.S. Thesis
S. J. MCNAMARA Dec. 1983 123 p
(AD-A136803; AD-E301284; AFIT/GA/AA/83D-6) Avail: NTIS HC A06/MF A01 CSCL 01B

The evasion problem was studied using a nonlinear simulation to simulate target and missile dynamics. The simulation applied drag, lag, acceleration bounding and other limits to the missile and target. The effect of using three variations of proportional guidance were studied: classic (cross product steering); radar (velocity of closure is used) and heat (the missile has angle and angle rate information only). The target used constant turn maneuver and a switching maneuver, both of which were evaluated for sensitivity to timing, aspect angle, missile velocity, seeker biasing and proportional guidance type. The missile was lethal against any constant turn sustained by the target for more than one to two seconds. Constant turn evasion maneuvers caused the largest misses and the least sensitivity to timing errors from head-on and front quarter intercepts. The switching maneuver was much better at evading the missile than the constant break turn. The largest misses for the switching maneuver occurred from a head-on aspect. Maneuver execution orthogonal to the missile guidance plane was paramount and in independent of the maneuver attempted. The proportional guidance type had little effect on the maximum miss achieved, especially for the switching maneuver; however, guidance type strongly affected the timing of the best maneuver. The missile was an order of magnitude more sensitive to biasing of its angle measurements than to biasing of its angle rate, range or range rate measurements. The effect of biasing needed to be coordinated with the target maneuver, otherwise the net effect each had on the missile seeker could cancel. GRA

N84-19339# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
AN OPEN LOOP MISSILE EVASION ALGORITHM FOR FIGHTERS M.S. Thesis
G. E. STRAIGHT Nov. 1983 128 p
(AD-A136834; AFIT/GAE/AA/83D-7) Avail: NTIS HC A07/MF A01 CSCL 12A

Proportional navigation (PN) is a guidance law used on many missiles today. Closed loop missile evasion maneuvers for fighters flying against proportional navigation missiles have been investigated, but they all require that the fighter have relative state information that is currently unavailable. An open loop missile evasion algorithm is needed today to allow pilots to best maneuver their aircraft against PN guided missiles to improve the chances of survival. A preliminary investigation of fighter maneuvers revealed the strengths and weakness of particular maneuvers. Maximum g turns and barrel rolls were expected to show little increase in miss distance over a non-maneuvering target. A switching/jinking maneuver proved a good maneuver. A switching/jinking maneuver coupled with a last second bank reversal was thought to be the best evasive maneuver. The computer simulation TACTICS IV was used to simulate fighter/missile engagements. From those simulations the miss distance was calculated and used to determine the best fighter maneuver. As expected maximum g turns in any direction and barrel rolls proved to be the worst maneuvers. GRA

N84-19342# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
MINIMUM TIME TURNS WITH DIRECT SIDEFORCE M.S. Thesis
M. R. BRINSON Dec. 1983 85 p
(AD-A136958; AFIT/GAE/AA/83D-1) Avail: NTIS HC A05/MF A01 CSCL 20D

The objective of the study is to find the optimal trajectories and corresponding minimum turning times for a high performance aircraft with and without direct sideforce to perform a prescribed turn. These trajectories and times are then compared to evaluate

the benefit of direct sideforce. Optimal control theory is applied to solve the minimum time to turn optimal control problem using a suboptimal control problem approach and a second order parameter optimization method. The results indicate that the use of direct sideforce is beneficial in reducing turning time. In addition, the use of sideforce causes a small loss of energy for initial velocities lower and much higher than the corner velocity.
Author (GRA)

N84-19343# Vereinigte Flugtechnische Werke G.m.b.H., Bremen (West Germany).
CIVIL COMPONENT PROGRAM INTEGRATED WING-ENGINE-SYSTEM (IFAS), PHASE 1 Final Report, Mar. 1982
B. EWALD Bonn Bundesministerium fuer Forschung und Technologie Aug. 1983 88 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-W-83-018; ISSN-0170-1339) Avail: NTIS HC A05/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 18,50
Computational methods in subsonic and transonic regimes for flows with strong interference were developed. Transonic wing development was conducted using experimental and theoretical results. Canard wing configurations were investigated. For wings with strong interferance, the experimental investigations were focused on low speed engine simulation. A slat/flap-system for the transonic wing was developed and tested using a panel half-model.
Author (ESA)

N84-19344# Vereinigte Flugtechnische Werke G.m.b.H., Bremen (West Germany). Abt. Bauwesen.
LONG TERM IN-SERVICE EVALUATION OF CFRP COMPONENTS (SPOILERS) ON AIRBUS A300, PHASE 1 Final Report, Dec. 1982
G. PORSCHE Bonn Bundesministerium fuer Forschung und Technologie Oct. 1983 61 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-W-83-028; ISSN-0170-1339) Avail: NTIS HC A04/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 13
The in-service evaluation of 22 carbon fiber reinforced plastic (CFRP) spoilers is presented. Strength tests were performed on wet CFRP spoilers at 55 and 70 C. Based on experimental and theoretical verification, the component was fully certified. Stiffness measurements prior to installation show very small scattering.
Author (ESA)

N84-19345# Technische Hogeschool, Delft (Netherlands). Dept. of Aerospace Engineering.
LECTURE NOTES ON THE PRINCIPLES AND PRACTICE OF AIRPLANE PERFORMANCE PREDICTION. PART 1: BASIC ELEMENTS
G. J. J. RUIJGROK Aug. 1983 136 p Presented at Tech. Univ. of Bandung (ITB) Summer Course, Bandung, Indonesia, Aug. 1983 Sponsored by the Indonesian and Netherlands Governments 3 Vol.
(VTH-LR-385-VOL-1) Avail: NTIS HC A07/MF A01
Subsonic airplane performance prediction is introduced. Cartesian axis systems and angles; airplane condition, flight condition, and type of flight; atmosphere effects; measurement of altitude and airspeed; airplane aerodynamics; the piston engine and propeller; gas turbine engine characteristics and flight load factors are discussed.
Author (ESA)

N84-19346# Technische Hogeschool, Delft (Netherlands). Dept. of Aerospace Engineering.
LECTURE NOTES ON THE PRINCIPLES AND PRACTICE OF AIRPLANE PERFORMANCE PREDICTION. PART 2: POINT-PERFORMANCE IN STEADY SYMMETRIC AND UNSYMMETRIC FLIGHT
G. J. J. RUIJGROK Aug. 1983 137 p Presented at Tech. Univ. of Bandung (ITB) Summer Course, Bandung, Indonesia, Aug. 1983 Sponsored by the Indonesian and Netherlands Governments 3 Vol.
(VTH-LR-385-VOL-2) Avail: NTIS HC A07/MF A01
Performance prediction of subsonic airplanes in steady symmetric flight, and in steady symmetric glide is introduced. Power required and power available; performance prediction using analytical expressions for thrust and drag; effect of altitude and of changes of power available and airplane configuration; effect of weight on performance; and turning performance are discussed.
Author (ESA)

N84-19347# Technische Hogeschool, Delft (Netherlands). Dept. of Aerospace Engineering.
LECTURE NOTES ON THE PRINCIPLES AND PRACTICE OF AIRPLANE PERFORMANCE PREDICTION. PART 3: PATH PERFORMANCE IN QUASI STEADY AND UNSTEADY SYMMETRIC FLIGHT
G. J. J. RUIJGROK Aug. 1983 138 p refs Presented at Tech. Univ. of Bandung (ITB) Summer Course, Bandung, Indonesia, Aug. 1983 Sponsored by the Indonesian and Netherlands Governments 3 Vol.
(VTH-LR-385-VOL-3) Avail: NTIS HC A07/MF A01
Subsonic aircraft cruise performance prediction; criteria for the assessment of the economic value of airplane performance; climb and descent performance; takeoff performance; and landing performance are outlined.
Author (ESA)

N84-19348# Technische Hogeschool, Delft (Netherlands). Dept. of Aerospace Engineering.
SKETCH: A COMPUTER PROGRAM FOR PLOTTING A TRANSPORT AIRPLANE CONFIGURATION IN CONCEPTUAL DESIGN
C. BIL Jun. 1983 41 p refs
(VTH-LR-388) Avail: NTIS HC A03/MF A01
The computer program SKETCH, for automatically plotting an elementary airplane configuration drawing (wing + fuselage + tail planes + nacelles) was developed for conceptual design studies of transport airplanes. Wing and tail plane geometries are derived from the major design parameters, e.g., wing area, aspect ratio, sweep angle, tail volume coefficients. Nondimensional parameters are used to define the location of the components and to allow rapid reorientation without losing the coherency of the configuration. Results of SKETCH applied to existing airplanes are presented. Directions for use of the program are included.
Author (ESA)

N84-19867# Army Aviation Research and Development Command, St. Louis, Mo.
AVRADCOM RESEARCH HELICOPTER VIBRATION
S. C. STEVENS *In* Shock and Vibration Inform. Center The Shock and Vibration Bull., Part 1 p 3-20 May 1983 refs
Avail: SVIC, Code 5804, Naval Research Lab., Washington, D.C. 20375 CSCL 01C
Since the maiden flight in 1940, the Army helicopter has encountered a multitude of vibration problems. These problems have decreased system productivity and increased life cycle costs. Improvements were achieved, for the most part, by add-on vibration control devices designed to reduce rotor vibratory loads and airframe vibrations. Numerous vibration related problems still persist in the design of the modern helicopter. Today's vibration problems are more critical due to changes in overall mission requirements which include: nap-of-the-earth and high speed flight, advanced weapons delivery, survivability, transportability, high reliability, and low maintenance. Research efforts are directed towards vibration analysis, vibration control and vibration testing.
Author

N84-19869# Joint Technical Coordinating Group for Aircraft Survivability, Washington, D.C.
AIRCRAFT SURVIVABILITY
D. B. ATKINSON *In* Shock and Vibration Inform. Center The Shock and Vibration Bull., Part 1 p 33-38 May 1983
Avail: SVIC, Code 5804, Naval Research Lab., Washington, D.C. 20375 CSCL 01B

Survivability is defined by the NAVMAT Combat Survivability Instruction (NAVMATINST 3900.16) as the capability of a weapon system to continue to carry out its mission in a hostile threat environment and is a function of both susceptibility and vulnerability. Susceptibility takes into account those factors that determine whether the aircraft is hit by a threat and vulnerability takes into account those factors that determine whether the aircraft is killed by the threat mechanisms if it is hit. An overview of the Naval Air Combat Survivability Program and selected activities of the Tri-Service Joint Technical Coordinating Group on Aircraft Survivability (JTCG/AS) is presented. Author

N84-19886*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
EXPERIMENTAL AND ANALYTICAL INVESTIGATION OF ACTIVE LOADS CONTROL FOR AIRCRAFT LANDING GEAR
D. L. MORRIS (AFWAL) and J. R. MCGEHEE *In* Shock and Vibration Inform. Center The Shock and Vibration Bull., part 2 p 79-89 May 1983
Avail: SVIC, Code 5804, Naval Research Lab., Washington, D.C. 20375 CSCL 01C

A series hydraulic, active loads control main landing gear from a light, twin-engine civil aircraft was investigated. Tests included landing impact and traversal of simulated runway roughness. It is shown that the active gear is feasible and very effective in reducing the force transmitted to the airframe. Preliminary validation of a multidegree of freedom active gear flexible airframe takeoff and landing analysis computer program, which may be used as a design tool for active gear systems, is accomplished by comparing experimental and computed data for the passive and active gears. E.A.K.

06

AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

A84-23850
FLIGHT MANAGEMENT COMPUTER SYSTEMS
A. L. BLACKMAN Aerospace (UK) (ISSN 0305-0831), vol. 11, Feb. 1984, p. 12-16.

An assessment is made of the development prospects for Flight Management Computer Systems (FMCSs) on the basis of experience with the ARINC 702 all-digital FMCS. The FMCS is the nerve center for aircraft guidance, receiving inputs from three inertial reference systems, engines, autopilot, and flight control computer, routinely using these for extensive calculations. The computer systems employed must use nonvolatile memory to store not only the navigational data, but airframe and engine performance data. Attention is given to the rationale for the UV EPROM, CMOS RAM, and magnetic bubble hardware employed, the hardware's distributed processing system architecture and interfaces, system software, and the control and display units' procedures structure. O.C.

A84-25441
SYNTHESIS OF OPTIMAL SIGNAL-PROCESSING DEVICES IN A RADIO ALTIMETER FOR LOW ALTITUDES [SINTEZ USTROISTV OPTIMAL'NOI OBRABOTKI SIGNALOV V RADIOVYSOTOMERE MALYKH VYSOT]
IU. N. MOISEENKO Radiotekhnika (ISSN 0033-8486), Jan. 1984, p. 50-53. In Russian. refs

The Markov theory of optimal nonlinear filtering is used to synthesize devices for the optimal processing of signals in a radio altimeter for low altitudes. The synthesized device constitutes a nonlinear filter containing devices for estimating informatn parameters, devices for estimating terrain parameters, and a phase-locked loop assuring quasi-coherent signal processing. It is noted that the presence of a special linear filter assures good performance of the synthesized device in a wide range of terrain-parameter variation. B.J.

A84-25902
ASSEMBLY, CONTROL, AND TESTING OF AIRCRAFT INSTRUMENTATION (2ND REVISED AND ENLARGED EDITION) [SBORKA, REGULIROVKA I ISPYTANIE AVIATSIONNYKH PRIBOROV /2ND REVISED AND ENLARGED EDITION/]
Z. F. URAZAEV, B. A. ASS, IA. N. ALEKSEEV, and B. IA. MIASNIKOV Moscow, Izdatel'stvo Mashinostroenie, 1983, 288 p. In Russian. refs

General design questions, such as mechanization and automation, of the technological processes of assembly, adjustment, control, and testing of aircraft instrumentation are considered, and examples are given for the precision design of assembly joints on the basis of dimensional and electrical network theory. A study of the assembly of standard assembly units includes elastic sensitive elements, supports with sliding or rolling friction, electrical circuitry and elements with winding, and the balancing of moving parts. Also investigated are the adjustment and calibration of instruments with elastic sensitive elements, manometers, gyroscopes, and magnetic systems. Attention is given to standard electronic devices in aircraft instrumentation, as well as to mechanical, climatic, and electrical testing. J.N.

N84-19349# Analytic Sciences Corp., Reading, Mass.
LOGISTICS ENGINEERING DESIGN TECHNIQUES FOR FAULT-TOLERANT AVIONICS SYSTEMS Interim Report, Apr. 1982 - Jul. 1983
M. H. VEATCH, A. B. CALVO, and J. C. MCMANUS Brooks AFB, Tex. Air Force Human Resources Lab. Jan. 1984 60 p
(Contract F33615-82-C-0002; AF PROJ. 1710)
(AD-A137456; AFHRL-TP-83-41) Avail: NTIS HC A04/MF A01 CSCL 15E

The logistics analysis methods in this paper are appropriate for integrated, fault-tolerant systems, such as the Integrated Communication, Navigation, Identifications Avionics (ICNIA) program, early in the development cycle. In particular, fault tolerance is one feature that an ICNIA system must have if reliability and supportability cost benefits are to be realized. Historically, logistics engineering disciplines have been applied to new avionics designs in the later stages of development. However, the logistics engineering techniques in the early stages of design should not impose unrealistically detailed data requirements for analysis. This research in the areas of reliability, supportability, and survivability proceed by front-end analysis to determine the applicability of existing techniques. Both traditional and innovative maintenance concepts were investigated. In particular, the increased ability to sustain sorties with limited repair capability was evaluated for deferred repair policies. A detailed example is presented to demonstrate the reliability and supportability methodologies. The outputs of this research in each area consists of documented methods for evaluation of integrated, fault-tolerant designs and the associated logistics options, as well as specific evaluations and design feedback for the ICNIA designs. The Mission Reliability Model (MIREM) was developed to determine the reliability of avionics designs in the early stages of development while the *Simulation of Operational Availability/Readiness* (SOAR) model was

extended to describe the supportability parameters of the designs. GRA

N84-19352# *Anacapa Sciences, Inc., Santa Barbara, Calif.*
THE INTEGRATED MISSION-PLANNING STATION: FUNCTIONAL REQUIREMENTS, AVIATOR-COMPUTER DIALOGUE, AND HUMAN ENGINEERING DESIGN CRITERIA Final Technical Report, Oct. 1981 - Aug. 1983
S. P. ROGERS Aug. 1983 109 p Original contains color illustrations
(Contract DAAK80-81-C-0190)
(AD-A136909; REPT-475) Avail: NTIS HC A06/MF A01 CSCL 17G

This report describes the tasks conducted to provide detailed human factors engineering specifications for the construction and programming of the IMPS and the results of these tasks. The specific project objectives were to define IMPS functional requirements, design IMPS airborne hardware, design IMPS ground-based hardware, and to maximize the aviator-computer compatibility of the IMPS system. The project approach included a literature review, observation of the aviator task performances, interviews with subject matter experts, surveys, perceptual studies, human engineering analyses, detail design specification studies, and dialogue development analyses. The outcome of these efforts is described in terms of an overview of system components and functions, and detailed descriptions of operation of the airborne and ground-based portions of the IMPS system. Each of the major functions of the IMPS system is discussed, and the operational requirements, present deficiencies, IMPS capabilities, and IMPS operating procedures are identified. Appendices to the report provide hardware design criteria and a complete specification of the interactive dialogue system. GRA

07

AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and on-board auxiliary power plants for aircraft.

A84-23849
AERO ENGINE DEVELOPMENT - THE NEXT GENERATION
B. H. ROWE (General Electric Co, Fairfield, CT) Aerospace (UK) (ISSN 0305-0831), vol. 11, Feb. 1984, p. 5-11.

A development history is presented for aircraft gas turbine design and application, with a view to establishing the bases for judgments concerning future developments. The first mass-produced and, in 1949, commercial aviation-certified jet engine was the J-47, of which 35,000 were built at an averge cost of $32,000. Mach-2 military aircraft operation was achieved by engines of the J-79 technological generation, which were developed in the late 1950s. The efficiency of commercial jet transport was most directly affected by the decision to develop high bypass turbofan engines, which now power widebodied airliners. Prospective efficiency increases are seen through the development of advanced 'propfan' rotor turboprop engines, as well as turboshaft engines applicable to tilt-rotor VTOL aircraft. Engine production factory automation methods and improved research and development management are also noted as major aircraft engine development thrusts of consequence. O.C.

A84-23915
FILM COOLING EFFECTIVENESS ON A TURBINE BLADE
R. J. GOLDSTEIN, E. R. G. ECKERT (Minnesota, University, Minneapolis, MN), and Y. KORNBLUM (Elop Electro Optic Industries, Rehovot, Israel) (Israel Society of Aeronautics and Astronautics, Annual Conference on Aviation and Astronautics, 24th, Tel Aviv and Haifa, Israel, Feb. 17, 18, 1982) Israel Journal of Technology (ISSN 0021-2202), vol. 20, no. 4-5, 1982, p. 193-200. Navy-Army-supported research. refs

The effectiveness of film cooling on turbine blades in a linear cascade has been measured using a mass transfer analogy. The present study examines the importance of curvature on film cooling with two rows of staggered injection holes on both the pressure (concave) and suction (convex) sides of a turbine blade. Comparisons are made with earlier studies, particularly with one in which a single row of holes is used to provide the film cooling on convex and concave surfaces and another in which a flat surface was studied which had injection through two staggered rows of holes. The results of the experiments indicate that curvature plays an important role in determining film-cooling effectiveness even with multiple-row injection. At low and moderate blowing rates the effectiveness is better on a convex than on a concave surface. At high blowing rates the effectiveness is not greatly influenced by the surface curvature. The influence of curvature, however, is much less than was found with injection through a single row of holes where the individual jets tend to act more independently. In general, the two rows of holes provide higher effectiveness on any of the surfaces than does a single row of holes - certainly at the same blowing rate and, in general, also for the same mass addition per unit span of the blade. Author

A84-24033*# General Electric Co., Cincinnati, Ohio.
NASA/GENERAL ELECTRIC BROAD-SPECIFICATION FUELS COMBUSTION TECHNOLOGY PROGRAM - PHASE I.
W. J. DODDS, E. E. EKSTEDT, D. W. BAHR (General Electric Co., Aircraft Engine Business Group, Cincinnati, OH), and J. S. FEAR (NASA, Lewis Research Center, Cleveland, OH) Journal of Energy (ISSN 0146-0412), vol. 7, Nov.-Dec. 1983, p. 508-517. refs

Previously cited in issue 17, p. 2687, Accession no. A82-35000

A84-24042#
CORRELATION OF GAS TURBINE COMBUSTOR EFFICIENCY
P. A. LEONARD and A. M. MELLOR (Purdue University, West Lafayette, IN) Journal of Energy (ISSN 0146-0412), vol. 7, Nov.-Dec. 1983, p. 596-602. Army-supported research. refs

A new model is proposed to correlate combustion efficiency from gas turbine combustors, including fuel type and atomization effects. The model includes two zones in which evaporation, mixing, and kinetic processes occur. Time scales are defined to model these processes, and an expression is written for combustion inefficiency in terms of these scales. Data for four combustors, and for fuels in the range from JP-4 to DF-2, are correlated. The model reproduces the primary empirical observations and represents a significant extension of previously proposed correlations. Author

A84-24184#
CIVIL TURBOFAN PROPULSION SYSTEM INTEGRATION STUDIES USING POWERED TESTING TECHNIQUES AT ARA, BEDFORD
A. E. HARRIS and K. C. PALIWAL (Aircraft Research Association Ltd., Bedford, England) IN: Aerodynamic Testing Conference, 13th, San Diego, CA, March 5-7, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 74-98. refs
(AIAA PAPER 84-0593)

A relatively comprehensive development test approach to civil turbofan engine/airframe integration is discussed in terms of model testing and wind tunnel facilities. Testing techniques for isolated inlet and nozzle components are briefly described and sample data are used to identify some important aspects of the integration

of the engine and the nacelle/pylon. The aerodynamics of nacelle/pylon/wing is discussed and an integration test plan for identifying important installation and interference effects is defined. A Mach simulation tank for calibrating nacelle models is described which can identify aircraft drag increments of one third of one percent. An approach to assessing the influence of fan rpm-dependent sampling effects on the measured nozzle/duct pressures and temperatures and derived fan nozzle coefficients is presented in which the relationships between the 'true' and the 'measured' values of duct total pressures and temperatures are computed directly from the derived nozzle coefficients. C.D.

A84-24565
ACOUSTIC RESONANCES AND BLADE VIBRATION IN AXIAL FLOW COMPRESSORS
R. PARKER (Swansea, University College, Swansea, Wales) Journal of Sound and Vibration (ISSN 0022-460X), vol. 92, Feb. 22, 1984, p. 529-539. Research supported by Rolls-Royce, Ltd. and Science and Engineering Research Council. refs

In the design and development of axial flow compressors, an important consideration is that the stress amplitudes associated with blade vibration must not exceed safe values at any intended operating speed. The present investigation is concerned with calculated results which are based on very simple mathematical models of the acoustic properties of a compressor annulus and of the possible excitation processes which can exist in a compressor when some blades are operating in a stalled condition. Attention is given to trends in annulus profile, acoustic wave propagation, compressor speed and sources of excitation, the calculation of amplitude distributions, and resonance frequencies and blade excitation. G.R.

A84-24750
ANALYSIS OF THE EFFECTIVENESS OF VARIOUS DIAGNOSIS PROCEDURES FOR THE ASSESSMENT OF THE TECHNICAL CONDITION OF THE NK-8-4 ENGINES [EFFEKTIVITAETSANALYSE VERSCHIEDENER DIAGNOSEVERFAHREN ZUR EINSCHAETZUNG DES TECHNISCHEN ZUSTANDS VON TRIEBWERKEN NK-8-4]
S. JUNG (Interflug Gesellschaft fuer Internationalen Flugverkehr mbH, Berlin, East Germany) Technisch-oekonomische Information der zivilen Luftfahrt (ISSN 0232-5012), vol. 19, no. 5, 1983, p. 152-159. In German.

It is the aim of every enterprise engaged in air transport operations to achieve an economical utilization of the available equipment under conditions which provide a high level of safety. In this connection, a search for new diagnosis and prognosis procedures is conducted, and possibilities are explored for making better use as before of the available installations for the assessment of the technical conditions of the aircraft. Fundamental criteria for conducting comparisons of assessment procedures are discussed. These criteria are employed as a basis for an evaluation of the efficiency of a number of procedures for the determination of the technical condition of the engines. The criteria considered include accuracy, sensitivity, and information content. Four assessment procedures regarding the engine condition are compared. One is found to have significant advantages with respect to the other three. Its implementation requires, however, an installation of automatic data acquisition equipment in the aircraft. G.R.

A84-24770
EXCITATION OF VIBRATIONS IN THE FAN IMPELLERS OF AIRCRAFT GAS TURBINE ENGINES [VOZBUZHDENIE KOLEBANII RABOCHIKH KOLES VENTILIATOROV AVIATSIONNYKH GTD]
V. V. MALYGIN Problemy Prochnosti (ISSN 0556-171X), Feb. 1984, p. 85-89. In Russian. refs

The principles governing the interaction between the fan blades of aircraft gas turbine engines and the gasdynamic flow are examined. It is shown that the nature and the extent of this interaction are largely determined by the type of the exciting aerodynamic load. The efficiency of a statistical approach to the interpretation of the stochastic vibrations of blades under nonstationary loading is demonstrated. The predictions of the model proposed here are found to be in good agreement with experimental data. V.L.

A84-24986*# General Electric Co., Cincinnati, Ohio.
V/STOL PROPULSION CONTROL TECHNOLOGY
H. BROWN (General Electric Co., Aircraft Engine Business Group, Cincinnati, OH) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 7, Mar.-Apr. 1984, p. 183-189. NASA-supported research. refs

Previously cited in issue 05, p. 656, Accession no. A82-16909

A84-25179#
SYSTEMS FOR THE AUTOMATIC RECORDING AND PROCESSING OF TEST RESULTS FOR GAS TURBINE ENGINES [SYSTEMY AUTOMATYCZNEJ REJESTRACJI I OPRACOWYWANIA WYNIKOW BADAN ODRZUTOWYCH SILNIKOW TURBINOWYCH]
J. MAZURKIEWICZ Instytut Lotnictwa, Prace (ISSN 0509-6669), no. 94, 1983, p. 59-67. In Polish.

The paper describes the computer programs for the data recording and processing system used at the Instytut Lotnictwa for routine tests of gas turbine engines, including measurements of the temperature fields behind the turbine and engine performance characteristics. Examples of measurement results are presented in the form of BENSON plotter graphics. B.J.

A84-25413
SHAPING THE TECHNOLOGY OF AIRCRAFT PROPULSION
A. G. NEWTON (Rolls-Royce, Ltd., London, England) (Rolls-Royce European Symposium, Reims, France, May 27, 28, 1983) Aeronautical Journal (ISSN 0001-9240), vol. 88, Jan. 1984, p. 413-418.

A discussion is presented concerning the gas turbine engine technology development goals and management practices of a major manufacturer, with attention to the engine configuration-influencing imperatives of lower specific fuel consumption, higher turbine inlet temperatures, and the adequate demonstration of crucial engine components within development schedule constraints. The generation of a family of high bypass turbofan civil aviation engines, low bypass turbofan military trainer and light attack aircraft engines, industrial/marine powerplants, and turboprop/turboshaft engines, all from the RB 401 'core,' is taken as a paradigmatic case of economical technology development. Attention is also given to results to date of the development program of the RB 211 high bypass turbofan engine family. O.C.

A84-25414
LARGE TURBOFANS TO THE YEAR 2000
M. R. WILLIAMS (Rolls-Royce, Ltd., Derby, England) (Rolls-Royce European Symposium, Reims, France, May 27, 28, 1983) Aeronautical Journal (ISSN 0001-9240), vol. 88, Jan. 1984, p. 419-426.

In striving to improve the efficiency of airliner turbofan engine systems, it is essential to avoid design overcomplication which could result in higher acquisition costs, loss of service life or reliability, or an increase in maintenance requirements. Attention is presently given to the efficiency improvements which may be obtained from the application of several advanced component technologies which convert the current, high efficiency RB 211-542 D4 engine into the RB 211-535 E4 variant. These technologies include a wide chord snubberless fan, the use of three-dimensionally matched aerodynamic flow blading in both compressor and turbine sections, the minimization of air flow leakage through improved blade and seal clearance control, and the reduction of installation efficiency losses through the use of a common nozzle for the fan bypass and core flows. O.C.

A84-25415
THE REGENERATION OF THE TURBOPROP
J. F. COPLIN (Rolls-Royce, Ltd., London, England) (Rolls-Royce European Symposium, Reims, France, May 27, 28, 1983) Aeronautical Journal (ISSN 0001-9240), vol. 88, Jan. 1984, p. 427-434.

Prospective market demand for a family of 2000-3000 shp turboprop and turboshaft engines is projected to be met by the low cost, high fuel efficiency variants of the RTM322 engine which is currently under development. Also projected is a family of engines in the 8000 shp class for short to medium range 100-150 passenger aircraft. The technologies to be incorporated in these advanced engines include transonic, air-cooled turbine blades, a 20:1 pressure ratio compressor, ceramic high pressure turbine shrouds, propfan rotors, and turbofan-prop 'dual cycle' configurations. O.C.

A84-25555
AN APPLICATION SOFTWARE PACKAGE FOR THE PREDICTION OF ENGINE PARAMETERS (HOMOGENEOUS COMBUSTION PRODUCTS) [PAKET PRIKLADNYKH PROGRAMM DLIA PROGNOZIROVANIIA PARAMETROV DVIGATELIA / GOMOGENNYE PRODUKTY SGORANIIA/]
V. E. ALEMASOV, A. F. DREGALIN, I. K. ZHUKOVA, R. L. ISKHAKOVA, V. G. KRIUKOV, A. G. SENIUKHIN, and R. KH. KHASANOV Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 3, 1983, p. 10-14. In Russian. refs

An application software package designed for computing the flow parameters of a reacting gas in a Laval nozzle is briefly described. The software allows the computation of ideal flow characteristics (chemically equilibrium one-dimensional flow) and of specific pulse losses due to chemical nonequilibrium, dissipation, and wall friction in axisymmetric flows. The package, which contains about 60 subroutines written in FORTRAN-IV, has been successfully tested on a number of fuel mixtures, including F2 + H2, O2 + kerosine, air + natural gas, and N39.92O26.93 + C62.34H247.75 + K. V.L.

A84-25564
A STUDY OF FUEL EVAPORATION IN THE PRECOMBUSTION CHAMBER [ISSLEDOVANIE PROTSESSA ISPARENIIA TOPLIVA V PREDKAMERE]
V. M. IANKOVSKII, I. A. OBRAZTSOV, and I. KH. SABIROV Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 3, 1983, p. 50-54. In Russian.

The performance of two types of precombustion chamber (with and without a nozzle) for a gas turbine engine has been evaluated experimentally. It is shown that a nozzle installed inside a precombustion chamber accelerates fuel homogenization, resulting in a mean mass evaporation ratio of 0.93 for the range of design and process variables studied. A computational model is developed which makes it possible to calculate the fuel evaporation rate within the precombustion chamber. The model predictions are shown to be accurate to within 7-26 percent. V.L.

A84-25567
AN EXPERIMENTAL STUDY OF THE AERODYNAMIC SHIELDING OF THE AIR INTAKE OF A TURBOJET ENGINE FROM THE EXHAUST GASES [EKSPERIMENTAL'NOE ISSLEDOVANIE AERODINAMICHESKOI ZASHCHITY VOZDUKHOZABORNIKA TRD OT VYKHLOPNYKH GAZOV]
M. M. VYSOKOGORETS, M. SH. GILIAZOV, V. A. KOSTERIN, and M. G. KHABIBULLIN Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 3, 1983, p. 60-63. In Russian.

The use of an aerodynamic shield is a promising method for preventing the entry of high-temperature exhaust gases into the intake of a turbojet engine during the landing of aircraft equipped with reverse-thrust devices. The objective of the study reported here was to investigate experimentally the efficiency of aerodynamic shielding by a single circular jet issuing in the plane of symmetry of the intake at 90 deg to the surface of the runway. The mean temperature at the air intake is determined as a function of the total air pressure and of the critical flow rate of the shielding air for a turbojet engine intake model. V.L.

A84-25568
DETERMINATION OF TOTAL PRESSURE LOSSES IN STEPPED ANNULAR DIFFUSERS WITH CURVED OUTER WALLS AND A HOMOGENEOUS INLET VELOCITY FIELD [OPREDELENIE POTER' POLNOGO DAVLENIIA V STUPENCHATYKH KOL'TSEVYKH DIFFUZORAKH S KRIVOLINEINYMI NARUZHNYMI STENKAMI I RAVNOMERNYM POLEM SKOROSTI NA VKHODE]
A. IA. DANTSYG and N. M. PETROV Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 3, 1983, p. 63-66. In Russian.

Gas flow and total pressure losses in annular diffusers have been investigated experimentally for various shapes of the outer wall generatrix and inlet velocities. The experimentally determined pressure loss data are generalized and presented in the form of polynomials of third degree. It is shown that the advantages of diffusers with curved outer walls are realized at relative inlet velocities higher than 0.3. At a relative inlet velocity of 0.7, total pressure losses in a diffuser with an optimally curved outer wall are 25 percent lower than those in diffusers with a rectilinear generatrix of the outer wall. V.L.

A84-25569
IMPROVING THE PARAMETERS OF A GAS TURBINE ENGINE BY INJECTING WATER INTO THE AIR THAT COOLS THE TURBINE [ULUCHSHENIE PARAMETROV GTD PRI VPRYSKE VODY V VOZDUKH, OKHLAZHDAIUSHCHII TURBINU]
G. M. GORELOV, V. P. DANILCHENKO, and V. E. REZNIK Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 3, 1983, p. 66-70. In Russian. refs

Two methods of reducing the temperature of the cooling air in a high-pressure turbine, one involving injection of water and the other the use of a heat exchanger, are analyzed. It is shown that even for moderate relative cooling depths of the blades (0.4-0.5), the injection of water into the cooling system makes it possible to substantially reduce the specific fuel consumption of the engine. The use of a heat exchanger, however, leads to a noticeable increase in fuel consumption during cruising flight due to hydraulic losses. V.L.

A84-25570
DETERMINATION OF THE ANGULAR ROTOR SPEED DURING THE COMPUTER-AIDED DESIGN OF A VOLUTE PUMP [K VOPROSU OPREDELENIIA UGLOVOI SKOROSTI VRASHCHENIIA ROTORA PRI RASCHETE SHNEKOTSENTROBEZHNOGO NASOSA NA EVM]
L. V. GORIUNOV, T. I. ZAKIRIANOV, and B. I. SOKOLOV Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 3, 1983, p. 70-73. In Russian.

A computer program written in FORTRAN is used to determine the geometry and operating parameters of a volute pump corresponding to cavitation-free operation. An analysis of results shows that by imposing a limit on the diameter ratio of the rotor, it is possible to stabilize the angular rotational speed and improve the energy characteristics of the pump at high inlet pressures. It is also shown that a reduction in the axial inlet flow velocity below the optimum value improves the anticavitation characteristics of the pump while significantly decreasing its efficiency. V.L.

A84-25572
THE EFFECT OF THE SETTING ANGLE OF JET-COOLING NOZZLES ON THE TEMPERATURE AND STRESSED STATE OF A TURBINE DISK [VLIIANIE UGLA USTANOVKI SOPEL STRUINOGO OKHLAZHDENIIA NA TEMPERATURNOE I NAPRIAZHENNOE SOSTOIANIE DISKA TURBINY]
V. V. ZHUIKOV, E. I. LASHUK, and IU. I. IUNKEROV Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 3, 1983, p. 77-80. In Russian. refs

The temperature and stressed state of the disk of a small gas turbine engine with jet cooling are calculated for cooling nozzle angles of 60 and 90 deg with respect to the disk surface. It is found that the setting of the cooling nozzles at 60 deg decreases the mean disk temperature by more than 30 K (about 6 percent) and the temperature gradient between the hub and the rim of the

disk by more than 20 percent. As a result, the safety factor increases by up to 5 percent in the maximum stress region and up to 5.3 percent at the nozzles. V.L.

A84-25573
DETERMINATION OF THE DEPENDENCE OF SOOT FORMATION IN A PREMIXED FUEL-AIR COMBUSTION CHAMBER ON THE COMBUSTION PROCESS VARIABLES [K OPREDELENIIU ZAVISIMOSTI UROVNIA DYMLENIIA KAMERY SGORANIIA S PREDVARITEL'NYM SMESHENIEM TOPLIVA I VOZDUKHA OT PARAMETROV RABOCHEGO PROTSESSA]
M. P. KOLESOV Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 3, 1983, p. 80-82. In Russian.
By using the least squares method to statistically process the available experimental data, a regression equation is obtained for the amount of soot formed per unit mass of fuel during the combustion of a homogeneous air-fuel (TS-1) mixture. On the basis of this equation, an expression is obtained for the amount of soot formed in a premixed fuel-air combustion chamber for the excess air ratio range 0.3-0.55. The carbon emission level of the combustion chamber is then determined with allowance for both the formation and the gasification of solid carbon particles. V.L.

A84-25578
GENERALIZING TEST RESULTS FOR THE NOZZLE RINGS OF INWARD-FLOW MICROTURBINES USING THE METHOD OF REGRESSION ANALYSIS [OBOBSHCHENIE REZUL'TATOV PRODUVOK SOPLOVYKH APPARATOV TSENTROSTREMITEL'NYKH MIKROTURBIN METODOM REGRESSIONNOGO ANALIZA]
A. A. TROFIMOV, A. P. TUNAKOV, and V. A. UTOCHNIKOV Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 3, 1983, p. 92, 93. In Russian. refs
The results of a series of 129 independent tests on the nozzle rings of inward-flow microturbines are generalized using regression analysis to obtain an empirical expression relating the gasdynamic efficiency of the nozzle ring to various geometrical and operating characteristics. A regression model is derived which includes six functions having the greatest effect on the gasdynamic efficiency of the nozzle ring. The adequacy of the model is verified using the Fisher test. V.L.

A84-25579
SELECTING EXHAUST MIXERS FOR TURBOFAN ENGINES [K VYBORU SMESITELEI POTOKOV DLIA TRDD]
B. D. FISHBEIN Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 3, 1983, p. 94-96. In Russian. refs
The performance of a turbofan engine is analyzed to determine the optimum mass fractions of the core and bypass exhaust flows to be mixed. It is shown that in turbofan engines with high bypass ratios ($m = 4$-8), a maximum gain in thrust can be obtained by mixing approximately 60-30 percent of the air from the bypass exhaust (50-20 percent in the case of increased power losses) and about 80-100 percent of the gas from the core exhaust. By reducing the mass fractions of the exhaust flows to be mixed, it is possible to reduce the weight and dimensions of the mixer. V.L.

A84-25580
AN APPROACH TO THE DESIGN OF A SURGE PROTECTION DEVICE FOR THE COMPRESSOR OF A GAS TURBINE ENGINE [OB ODNOM PRINTSIPE POSTROENIIA USTROISTVA PROTIVOPOMPAZHNOI ZASHCHITY KOMPRESSORA GAZOTURBINNOGO DVIGATELIA]
M. M. SHAKIKIANOV Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 3, 1983, p. 98-99. In Russian.
In an earlier study (Kazakevich, 1974) a formal stability criterion has been proposed for the compressors of gas turbine engines which relates the acoustic mass of the suction line, La, to the acoustic flexibility of the air mass, Ca. The practical use of this criterion is, however, made difficult by the fact that the parameters La and Ca, to the acoustic flexibility of the air mass, Ca. The practical use of this criterion is, however, made difficult by the fact that the parameters La and Ca cannot be measured directly. An approach to the design of a surge detection and protection device on the basis of the La/kCa criterion is proposed in which use is made of the direct parameters of air flow. An implementation of the design algorithm proposed here is presented. V.L.

A84-25582
APPLICABILITY LIMITS FOR LINEAR MODELS DESCRIBING THE GAS PATH DYNAMICS OF AIRCRAFT ENGINES [O GRANITSAKH PRIMENIMOSTI LINEINYKH MODELEI DINAMIKI GAZOVYKH TRAKTOV DVIGATELEI LETATEL'NYKH APPARATOV]
A. V. BAIKOV Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 3, 1983, p. 101-104. In Russian. refs
An approach based on an analysis of the Burgers equation is used here to investigate the effect of various factors on the propagation of finite-amplitude waves in a gas line. An analysis of the solution obtained for waves of small finite amplitudes makes it possible to determine the applicability limits for linear models. Also, simple analytical expressions are obtained for determining whether the simplest linear model of gas path dynamics can be applied and whether the model should also include linearized convective transport and friction resistance terms. V.L.

A84-25598
ENVIRONMENTAL TESTING FOR CIVIL CERTIFICATE OF COMPOSITE PROPELLERS
W. J. COLCLOUGH (Dowty Rotol Ltd., Gloucester, England) Aircraft Engineering (ISSN 0002-2667), vol. 56, Feb. 1984, p. 2-9. refs
Composite propeller blades must be protected against impact damage, lightning strokes, abrasion, erosion, and weathering. Current aircraft propeller blades employ an epoxide injection resin system in both skin and spar. It is shown by a combination of panel tests and component tests that a composite propeller of this design withstands at least ten years of weathering without degradation, except to the replaceable polyurethane erosion protection. The component tests have demonstrated that the blade will withstand bird strike airworthiness requirements, and lightning strike tests have shown that the discharges attach themselves to a conductor at the top of a blade and are led away without damage to the composite structure. O.C.

A84-26068
535E4 - THE INSIDE STORY
D. VELUPILLAI Flight International (ISSN 0015-3710), vol. 125, Feb. 25, 1984, p. 510-514.
A discussion is presented concerning the design, testing and development schedule by means of which the RB.211-535E4 advanced technology variant of the RB.211-535C high bypass turbofan airliner engine was produced. Attention is given to the design feature differences between the 535C and 535E4 variants, which include wide-chord, Ti-honeycomb core construction fan blades, 'end-bend' airfoil high pressure compressor blades, a three-dimensional airfoil high pressure nozzle guide vane configuration, and a common nozzle for the fan and core exhausts. Development program milestone and performance comparisons are conducted not only between the two variants in question, but also with the PW2037 advanced turbofan, which is the main competitor with the 535C and 535E4 for the fleet of 757 wide body airliners. O.C.

N84-18202*# Santa Clara Univ., Calif. School of Engineering.
SECONDARY FLOW SPANWISE DEVIATION MODEL FOR THE STATORS OF NASA MIDDLE COMPRESSOR STAGES
W. B. ROBERTS and D. M. SANDERCOCK Feb. 1984 40 p refs
(Contract NAG3-212)
(NASA-CR-173360; NAS 1.26:173360) Avail: NTIS HC A03/MF A01 CSCL 21E
A model of the spanwise variation of deviation for stator blades is presented. Deviation is defined as the difference between the passage mean flow angle and the metal angle at the outlet of a

blade element of an axial compressor stage. The variation of deviation is taken as the difference above or below that predicted by blade element, (i.e., two-dimensional) theory at any spanwise location. The variation of deviation is dependent upon the blade camber, solidity and inlet boundary layer thickness at the hub or tip end-wall, and the blade channel aspect ratio. If these parameters are known or can be calculated, the model provides a reasonable approximation of the spanwise variation of deviation for most compressor middle stage stators operating at subsonic inlet Mach numbers. A.R.H.

N84-18203*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
FLIGHT EVALUATION OF THE DEEC SECONDARY CONTROL AIR-START CAPABILITY Final Report
J. B. JOHNSON and J. NELSON Dec. 1983 21 p refs
Prepared in cooperation with NASA, Dryden Flight Research Center
(NASA-TM-84910; H-1186; NAS 1.15:84910) Avail: NTIS HC A02/MF A01 CSCL 21E

The air-start capability of a secondary engine control (SEC) was tested for a DEEC-equipped F100 engine and installed in an F-15 airplane. Two air-start schedules were tested. The first was referred to as the group I schedule; the second or revised schedule was the group II start schedule. Using the group I start schedule, an airspeed of 300 knots was required to ensure successful 40- and 25-percent SEC-mode air starts. If N2 were less than 40 percent, a stall would occur when the start bleeds closed 40 sec after initiation of the air start. All JFS-assisted air starts were successful with the group start schedule. For the group II schedule, the time between pressurization and start-bleed closure ranged between 50 and 72 sec depending on altitude. All air starts were successful above 225 knots givin a 75-knot reduction in required airspeed for a successful air start. Spooldown air starts of 40 percent were successful at 200 knots at altitudes up to 10,650 m and at 175 knots at altitudes up to 6100 m. Idle rpm was lower than the desired 65 percent for air starts at higher altitudes and lower airspeeds. All JSF-assisted air starts were successful. Author

N84-18204# Applied Physics Lab., Johns Hopkins Univ., Laurel, Md.
PARTICLE SIZING IN A FUEL-RICH RAMJET COMBUSTOR
R. TURNER and R. A. MURPHY Aug. 1983 103 p
(Contract N00024-83-C-5301)
(AD-A135632; JHU/APL/TG-1339) Avail: NTIS HC A06/MF A01 CSCL 12A

A laser Doppler velocimeter (LDV) has been used to measure the size, concentration, and velocity of individual particles having diameters ranging from 3 to greater than 100 micron and having velocities of 600 to 1400 m/s in the fuel-rich exhaust of a ramjet combustor. The visibility of the LDV output was used to measure particle diameters ranging from 3 to under 30 micron and the mean scattered amplitude was used to measure particles ranging from 20 to over 100 micron. The attenuation of one LDV beam provided information on the total amount of material present. Measurements were made along the flow field of a combustor operating at 35 psia, an inlet temperature of 650 to 850 K, and fuel equivalence ratios (ER) of 1.6 and 2.6. Typically, at a point one-half inch from the nozzle and for an ER of 2.6, the average particle velocity is 800 m/s, the average particle size is 50 micron, and the particle density is 250 particles per cubic centimeter. The large particles appear to be unburnt fuel. Author (GRA)

N84-18205# Universal Energy Systems, Inc., Dayton, Ohio.
MULTI-DUCTED INLET COMBUSTOR RESEARCH AND DEVELOPMENT Interim Report, 1 Sep. 1982 - 31 Aug. 1983
G. D. STREBY Wright-Patterson AFB, Ohio AFWAL Nov. 1983 70 p
(Contract F33615-81-C-2074; AF PROJ. 2308)
(AD-A135906; AFWAL-TR-83-2081; IR-2) Avail: NTIS HC A04/MF A01 CSCL 14B

Flow visualization studies and fluid flow residence time measurements were conducted of a dual inlet side dump combustor configuration utilizing the Water Tunnel test rig of the Ramjet Technology Branch AFWAL/PORT Wright-Patterson AFB, OH. Tests were conducted of the side dump combustor for inlet duct angles of 30, 45, and 60 degrees and for combustor dome plate positions from 0 to 6 inches forward of the inlet ducts. The nozzle area to combustor area ratio for all testing was 0.29. Tests were conducted with total flow rates of 200, 300, and 400 gals. per min. to give inlet duct Reynolds numbers of 125,640, 188,400 and 251,300 respectively. Preliminary visual observation investigations were also conducted of gas generator and symmetry flows. Engineering and technical support provided to other ramjet combustor test rigs of the Ramjet Technology Branch are detailed. Author (GRA)

N84-19353*# Pratt and Whitney Aircraft Group, East Hartford, Conn.
PARALLEL PROCESSOR ENGINE MODEL PROGRAM Final Report
P. MCLAUGHLIN Jan. 1984 70 p refs
(Contract NAS3-23283)
(NASA-CR-174641; NAS 1.26:174641; PWA-5896-21) Avail: NTIS HC A04/MF A01 CSCL 21E

The Parallel Processor Engine Model Program is a generalized engineering tool intended to aid in the design of parallel processing real-time simulations of turbofan engines. It is written in the FORTRAN programming language and executes as a subset of the SOAPP simulation system. Input/output and execution control are provided by SOAPP; however, the analysis, emulation and simulation functions are completely self-contained. A framework in which a wide variety of parallel processing architectures could be evaluated and tools with which the parallel implementation of a real-time simulation technique could be assessed are provided. Author

N84-19355# National Aerospace Lab., Amsterdam (Netherlands). Construction and Materials Div.
CORROSION AND CORROSION PREVENTION IN GAS TURBINES
A. J. A. MOM and H. J. KOLKMAN 30 Sep. 1982 42 p refs
In DUTCH; ENGLISH summary Presented at Corrosiedag 1982, Arnhem, Netherlands, 14 Sep. 1982
(NLR-MP-82048-U) Avail: NTIS HC A03/MF A01

The conditions governing the corrosion behavior in gas turbines are surveyed. Factors such as temperature, relative humidity, the presence of sulfur and nitrogen dioxide, and fuel quality are discussed. Electromechanical corrosion at relatively low temperature in compressors; oxidation; and hot corrosion (sulfidation) at high temperature in turbines are considered. Corrosion prevention by washing and rinsing, fuel additives, and corrosion resistant materials and coatings is reviewed. Author (ESA)

N84-19901# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio. Flight Dynamics Lab.
INVESTIGATION OF THE ACOUSTIC CHARACTERISTICS OF AIRCRAFT/ENGINES OPERATING IN A DRY-COOLED JET ENGINE MAINTENANCE TEST FACILITY
V. R. MILLER, G. A. PIZAK, J. M. CHINN, and R. J. REILLY *In* Shock and Vibration Inform. Center The Shock and Vibration Bull., part 3 p 105-114 May 1983 refs
Avail: SVIC, Code 5804, Naval Research Lab., Washington, D.C. 20375 CSCL 21E

A measurement program was undertaken to measure the acoustic environment in an Air Force hush house facility, during the operation of aircraft and uninstalled jet engines to ensure that structural sonic fatigue design limits were not exceeded. Data from external runway operations and other engine test facilities were also compared. The correspondence between noise levels at the hush house deflector ramp and the far-field was examined. The effect of axial levels inside the hangar was also investigated. M.G.

08

AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

A84-23910#
CALCULATION FOR ATTITUDE ANGLES OF AN ALL ATTITUDE AEROPLANE STRAPDOWN SYSTEM
Z. CHEN (Beijing Institute of Aeronautics and Astronautics, Beijing, People's Republic of China) Acta Aeronautica et Astronautica Sinica, vol. 4, Sept. 1983, p. 76-85. In Chinese, with abstract in English.

Several problems involved in the calculation of aircraft attitude angles are discussed and their solutions are presented. Definition regions for attitude angles are given in order to facilitate the determination of the single-valued angle position of an aircraft. A solution to the problem of the denominator or numerator of the independent variable in the arctangent function approaching zero is proposed. The values of attitude angles are determined directly, according to whether values of the numerator (or denominator) are positive or negative when the absolute value of the denominator (or numerator) is less than a small value, which depends on the accuracy of the system. A method for calculating the yaw angle is also presented and a program diagram for attitude angle calculation is given. Mathematical simulation results demonstrate the correctness of the theoretical analysis. C.D.

A84-24106#
ACTIVE SUPPRESSION OF AEROELASTIC INSTABILITIES ON A FORWARD-SWEPT WING
T. E. NOLL (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH), F. E. EASTEP (Dayton, University, Dayton, OH), and R. A. CALICO (USAF, Institute of Technology, Wright-Patterson AFB, OH) (Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers, Part 2, p. 577-588) Journal of Aircraft (ISSN 0021-8669), vol. 21, March 1984, p. 202-208. refs

Previously cited in issue 12, p. 1704, Accession no. A83-29869

A84-24987*# Purdue Univ., Lafayette, Ind.
QUADRATIC SYNTHHESIS OF INTEGRATED ACTIVE CONTROLS FOR AN AEROELASTIC FORWARD-SWEPT-WING AIRCRAFT
D. K. SCHMIDT, T. A. WEISSHAAR (Purdue University, West Lafayette, IN), and M. G. GILBERT (Guidance and Control Conference, San Diego, CA, August 9-11, 1982, Collection of Technical Papers, p. 675-684) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 7, Mar.-Apr. 1984, p. 190-196. refs
(Contract NAG1-157)

Previously cited in issue 03, p. 137, Accession no. A83-12458

A84-24988*# Princeton Univ., N. J.
EFFECTS OF DISPLACEMENT AND RATE SATURATION ON THE CONTROL OF STATICALLY UNSTABLE AIRCRAFT
G. D. HANSON (Engineer, Systems Technology, Inc., Mountain View, CA) and R. F. STENGEL (Princeton University, Princeton, NJ) (Guidance and Control Conference, Albuquerque, NM, August 19-21, 1981, Collection of Technical Papers, p. 35-49) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 7, Mar.-Apr. 1984, p. 197-205. refs
(Contract NSG-1587)

Previously cited in issue 21, p. 3623, Accession no. A81-44082

A84-24989*# Purdue Univ., Lafayette, Ind.
QUADRATIC OPTIMAL COOPERATIVE CONTROL SYNTHESIS WITH FLIGHT CONTROL APPLICATION
D. K. SCHMIDT (Purdue University, West Lafayette, IN) and M. INNOCENTI Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 7, Mar.-Apr. 1984, p. 206-214. refs
(Contract NAG4-1)

An optimal control-law synthesis approach is presented that involves simultaneous solution for two cooperating controllers operating in parallel. One controller's structure includes stochastic state estimation and linear feedback of the state estimates, while the other controller involves direct linear feedback of selected system output measurements. This structure is shown to be optimal under the constraint of linear feedback of system outputs in one controller. Furthermore, it is appropriate for flight control synthesis where the full-state optimal stochastic controller can be adjusted to be representative of an optimal control model of the human pilot in a stochastic regulation task. The method is experimentally verified in the case of the selection of pitch-damper gain for optimum pitch tracking, where optimum implies the best subjective pilot rating in the task. Finally, results from application of the method to synthesize a controller for a multivariable fighter aircraft are presented, and implications of the results of this method regarding the optimal plant dynamics for tracking are discussed. Author

A84-24998*# Kansas Univ., Lawrence.
USE OF DIFFERENTIAL PRESSURE FEEDBACK IN AN AUTOMATIC FLIGHT CONTROL SYSTEM
D. W. LEVY and J. ROSKAM (Kanasa, University, Lawrence, KS) (Guidance and Control Conference, San Diego, CA, August 9-11, 1982, Collection of Technical Papers, p. 519-524) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 7, Mar.-Apr. 1984, p. 250, 251. refs
(Contract NAG4-5)

Previously cited in issue 19, p. 2981, Accession no. A82-38981

A84-25177#
NUMERICAL SIMULATION OF AIRCRAFT SPIN [SYMULACJA NUMERYCZNA KORKOCIAGU SAMOLOTU]
A. SYDOW and W. ZDROJEWSKI Instytut Lotnictwa, Prace (ISSN 0509-6669), no. 94, 1983, p. 23-49. In Polish. refs

Numerical-simulation results are presented for the four phases of spin: initiation, fully developed spin, pulling-out, and dive. It is noted that the spin analysis must be carried out for a wide range of angle of attack; in the case of ordinary (noninverted) spin this

angle may vary from small negative values up to 90 deg. Attention is given to a simulation analysis of the response of the system to the operation of the controls during spin and the pulling-out maneuver. Results obtained with the MARSYAS simulation system are presented. B.J.

A84-25191#
A MATHEMATICAL MODEL FOR PERFORMANCE COMPARISONS OF DIFFERENT TYPES OF TAIL UNITS [PROPOSTA DI UN MODELLO MATEMATICO ATTO AL CONFRONTO FRA LE PRESTAZIONI DI DIFFERENTI TIPI DI IMPENNAGGI]
L. BORELLO (Torino, Politecnico, Turin, Italy) Ingegneria (ISSN 0035-6263), Nov.-Dec. 1983, p. 301-304. In Italian.

A mathematical model is developed to investigate and compare the performance of different horizontal-tailplane configurations, with a focus on an all-flying tail with reversible control. Expressions are obtained for balance, static stability of control, longitudinal static margin, short-period longitudinal dynamic behavior, and longitudinal maneuverability. T.K.

A84-25487* Information and Control Systems, Inc., Hampton, Va.
DESIGN AND FLIGHT TESTING OF A DIGITAL LANDING APPROACH AUTOPILOT
J. R. BROUSSARD (Information and Control Systems, Inc., Hampton, VA), W. H. BRYANT (NASA, Langley Research Center, Flight Control Systems Div., Hampton, VA), and D. R. DOWNING (Kansas, University, Lawrence, KS) IN: American Control Conference, San Francisco, CA, June 22-24, 1983, Proceedings. Volume 2 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 526-533. refs
(Contract NAS1-16303)

An important feature in General Aviation (GA) autopilots is the ability to intercept and hold the glideslope and localizer during a landing approach. Most General Aviation landing approach autopilots available today use analog systems. This paper presents the designs of digital landing approach autopilots for a General Aviation (NAVION) aircraft using modern linear quadratic control theory. Each constant gain, direct digitally designed autopilot operates synchronously at a slow rate (10 samples per second) and has modest memory requirements, i.e., a full state Kalman filter is not used. The autopilot is designed to track desired position trajectories constructed in an ILS or MLS terminal area using command generators. Alternative command errors for intercepting and holding the localizer beam centerline are investigated. Linear simulations and flight test results are presented demonstrating the successful application of the linear quadratic regulator approach. Author

A84-25489
BACK-UP FLIGHT CONTROL SYSTEM
T. A. SORENSEN (Grumman Aerospace Corp., Bethpage, NY) IN: American Control Conference, San Francisco, CA, June 22-24, 1983, Proceedings. Volume 2 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 540-545.

Problems related to longitudinal flight control on an aircraft are considered along with approaches for overcoming the arising difficulties. Possibilities regarding a 'Fly-by-Wire' (FBW) mechanization for the aircraft are discussed, taking into account also three separate threats to the digital FBW aircraft. It is found that any of these dangers add to the need for a back-up flight control system. A Back-Up Flight Control System (BUFCS) may be defined as one which will function to control the aircraft in lieu of the main flight control system over the most vital parts of the flight envelope. Attention is given to the evolution of the Concorde BUFCS, the analog electrical back-up flight control system, the fluidic back-up flight control system, and the lateral-directional BUFCS. G.R.

A84-25490
ARCHITECTURE TRADEOFFS WITH FLUIDIC BACKUP FLIGHT CONTROLS
W. C. KUHNEL (Vought Corp., Arlington, VA) and R. L. WOODS (Texas, University, Arlington, TX) IN: American Control Conference, San Francisco, CA, June 22-24, 1983, Proceedings. Volume 2 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 546, 547. refs

This paper summarizes flight control system architecture variations for a conventional tactical aircraft employing electronic fly-by-wire primary controls with fluidic backup controls. The study includes a comparative architecture study of the anticipated catastrophic failure rates, mission abort rates, and equipment reliability. Fluidic technology is selected as a backup flight control since the fluidic components are insensitive to the threats to the primary system. Author

A84-25505* Rensselaer Polytechnic Inst., Troy, N. Y.
A CASE FOR NONLINEAR MODEL SIMPLIFICATION IN THE DESIGN OF FLIGHT CONTROL SYSTEMS
A. A. DESROCHERS and R. Y. AL-JAAR (Rensselaer Polytechnic Institute, Troy, NY) IN: American Control Conference, San Francisco, CA, June 22-24, 1983, Proceedings. Volume 2 . New York, Institute of Electrical and Electronics Engineers, 1983 , p. 788-793. refs
(Contract NAG1-171)

An algorithm is presented for obtaining a reduced order or simplified nonlinear model of a nonlinear plant. The method provides a systematic approach for quickly finding the optimal simplified model of the system. Controllers are then designed around this nonlinear model and are used to control the original plant. An example design, for the F-8 aircraft, illustrates that the simplified model does indeed enable the design of a linear controller whose performance is indistinguishable from higher order optimal controllers for the original nonlinear plant. The net result is a simplified design procedure for effectively controlling complex nonlinear systems. Author

A84-25509
ADAPTIVE CONTROL ALGORITHM FOR FLUTTER SUPPRESSION
C. A. HARVEY (Honeywell Systems and Research Center, Minneapolis, MN) IN: American Control Conference, San Francisco, CA, June 22-24, 1983, Proceedings. Volume 2 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 801, 802. Research supported by Honeywell, Inc. and U.S. Air Force. refs

A control algorithm to detect flutter, discriminate between different possible cases, and suppress flutter is discussed. The algorithm consists of an initialization and four major processing sections. In the first section, accelerometer outputs are combined and filtered, and segments of the outputs of this process are stored together with filtered control inputs. In the second section, the data are processed for detection and discrimination. Parameter estimates are computed and control gains are updated in the third section. The control command is computed in the fourth section. The algorithm has been successfully demonstrated in wind tunnel tests. C.D.

A84-25528* Information and Control Systems, Inc., Hampton, Va.
ACTIVE FLUTTER CONTROL USING DISCRETE OPTIMAL CONSTRAINED DYNAMIC COMPENSATORS
J. R. BROUSSARD and N. HALYO (Information and Control Systems, Inc., Hampton, VA) IN: American Control Conference, San Francisco, CA, June 22-24, 1983, Proceedings. Volume 3 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 1026-1034. refs
(Contract NAS1-16772)

A method for synthesizing digital active flutter suppression controllers using the concept of optimal output feedback is presented. A recently developd convergent algorithm is employed to determine constrained control law parameters that minimize an

infinite-time discrete quadratic performance index. Low-order compensator dynamics are included in the control law and the compensator parameters are computed along with the output feedback gain as part of the optimization process. An input noise adjustment procedure is used to improve the stability margins of the digital active flutter controller. Results from investigations into sample rate variation, prefilter pole variation, and effects of varying flight condtions are discussed. The study indicates that a digital control law which accommodates computation delay can stabilize the wing with reasonable rms performance and adequate stability margins. Author

A84-25534
DIGITAL AUTOPILOT DESIGN AND EVALUATION FOR FAMMS (FUTURE ARMY MODULAR MISSILE SYSTEM)
M. L. BUTLER and H. L. PASTRICK (Control Dynamics Co., Huntsville, AL) IN: American Control Conference, San Francisco, CA, June 22-24, 1983, Proceedings. Volume 3 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 1062-1067. refs

In 1978, the U.S. Army Missile Command (MICOM) initiated research directed toward advancing the state-of-the-art in guidance and control technology for Future Army Modular Missile Systems (FAMMS). It was found that new guidance and control theory and implementation would be required to meet the projected battlefield environment of the 1990s and beyond. In addition, advances in other disciplines of the missile system would also be needed. As a result of these findings, research was conducted on the missile airframe, propulsion, sensors, and target acquisition systems. Attention is given to the missile airframe, the aerodynamic transfer functions, the autopilot design, rate loop design, acceleration loop design, the implementation of the control system in simulation, and aspects of parameter plane redesign. G.R.

A84-25549
APPLICATION OF MIMO PHASE AND GAIN MARGINS TO THE EVALUATION OF A FLIGHT CONTROL SYSTEM
K. M. SOBEL, J. C. CHUNG, and E. Y. SHAPIRO (Lockheed-California Co., Burbank, CA) IN: American Control Conference, San Francisco, CA, June 22-24, 1983, Proceedings. Volume 3 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 1286, 1287. refs

In recent years, extensive research has been conducted regarding the robustness criteria of multiinput multioutput feedback control systems and their relation to the classical gain and phase margins. The present investigation is concerned with two examples for the evaluation of a flight control system, taking into account a commercial transport aircraft modelled by an LTI system with two inputs and four outputs and a fighter aircraft modelled by two inputs and five outputs. The MIMO stability margins are computed by using both the return difference matrix and the inverse return difference matrix. G.R.

A84-25553* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
MODELS AND ANALYSIS FOR TWIN-LIFT HELICOPTER SYSTEMS
J. LEWIS (NASA, Ames Research Center, Moffett Field, CA) and C. MARTIN (Case Western Reserve University, Cleveland, OH) IN: American Control Conference, San Francisco, CA, June 22-24, 1983, Proceedings. Volume 3 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 1324, 1325. refs
(Contract NAG2-82; NSG-2384; DE-AC01-80RA-50256)

The major limitation of a modern helicopter with respect to its employment in transport operations has been a relatively small payload size. Among several ideas for overcoming this limitation are a number of multiple-lift schemes using two or more helicopters to lift payloads too large for a single helicopter. On a number of occasions, pairs of helicopters carrying a single load have been successfully employed. However, a considerable amount of flying skill was required in these cases in connection with the manual control tasks involved. Some form of automatic control will, therefore, be needed until twin-lift operations become generally practical. The present investigation is concerned with the development of models of the Twin-Lift System which can be used as a basis for the design of automatic control. G.R.

A84-26321
FLIGHT AT THE SPEED OF LIGHT
G. WARWICK Flight International (ISSN 0015-3710), vol. 125, March 3, 1984, p. 585, 586.

Attention is given to the rotary wing aircraft fiber-optic flight control, or 'fly-by-light' system that is being developed for the U.S. Army's Advanced Digital Optical Control System (ADOCS) requirement. Because there are no electrical elements in the optical transducers employed, they are invulnerable to interference from electronic countermeasures or the strong electromagnetic pulse generated by a nuclear explosion. It is also estimated that ADOCS will reduce control system weight by 25 percent for a 9000-lb helicopter, saving 250 lb. This reduction may be as great as 50 percent for larger rotorcraft, such as the JVX tilt-rotor aircraft, and 70 percent for heavy lift helicopters. O.C.

N84-18206*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
RECONFIGURABLE MULTIVARIABLE CONTROL LAW FOR COMMERCIAL AIRPLANE USING A DIRECT DIGITAL OUTPUT FEEDBACK DESIGN
A. J. OSTROFF and R. M. HUESCHEN Feb. 1984 55 p refs
(NASA-TM-85759; NAS 1.15:85759) Avail: NTIS HC A04/MF A01 CSCL 01C

The ability of a pilot to reconfigure the control surfaces on an airplane after a failure, allowing the airplane to recover to a safe condition for landing, becomes more difficult with increasing airplane complexity. Techniques are needed to stabilize and control the airplane immediately after a failure, allowing the pilot time to make longer range decisions. This paper shows a design of a discrete multivariable control law using four controls for the longitudinal channel of a B-737. Single control element failures are allowed in three of the four controls. The four controls design and failure cases are analyzed by means of a digital airplane simulation, with regard to tracking capability and ability to overcome severe windshear and turbulence during the aproach and landing phase of flight. Author

N84-18207*# Purdue Univ., Lafayette, Ind. School of Aeronautics and Astronautics.
THE INTEGRATED MANUAL AND AUTOMATIC CONTROL OF COMPLEX FLIGHT SYSTEMS Semiannual Status Report, 1 Jul. 1983 - 31 Jan. 1984
D. K. SCHMIDT 17 Feb. 1984 137 p refs
(Contract NAG4-1)
(NASA-CR-173308; NAS 1.26:173308) Avail: NTIS HC A07/MF A01 CSCL 01C

A unified control synthesis methodology for complex and/or non-conventional flight vehicles are developed. Prediction techniques for the handling characteristics of such vehicles and pilot parameter identification from experimental data are addressed. Author

N84-18208# National Aerospace Lab., Tokyo (Japan). Airframe Div.
NUMERICAL SIMULATION OF TRANSONIC FLUTTER OF A HIGH-ASPECT-RATIO TRANSPORT WING
K. ISOGAI Aug. 1983 19 p refs
(NAL-TR-776T; ISSN-0389-4010) Avail: NTIS HC A02/MF A01

The transonic flutter of a wind tunnel model of a slender transport wing with supercritical airfoil sections was simulated using the USTD3 computer code which solves the unsteady 3D full potential equation by a two step semi-implicit time marching finite difference technique. In order to correct the mean steady-state location and strength of the shock wave, a 2D strip turbulent boundary layer technique was incorporated into the program. The flutter boundary and frequencies predicted by the numerical simulation show satisfactory agreement with those of the experiment. In particular, the flutter dynamic pressure and Mach

number where the transonic dip was experienced in the experiment are well predicted by USTF3. The behavior of the unsteady aerodynamic forces on this wing oscillating in pitch is also studied. Author

N84-18209# *Bolt, Beranek, and Newman, Inc., Cambridge, Mass.*
A PILOT/VEHICLE MODEL ANALYSIS OF THE EFFECTS OF MOTION CUES ON HARRIER CONTROL TASKS Final Report, Mar. 1981 - Mar. 1982
S. BARON Sep. 1983 255 p
(Contract N61339-80-D-0014)
(AD-A136291; NAVTRAEQUIPC-80-D-0014-0019-1) Avail: NTIS HC A12/MF A01 CSCL 01C

In this study, the results of an analytical investigation of pilot control of a simulated AV-8B (Harrier) aircraft are presented. The analysis was performed using a well-established pilot-vehicle model, namely, the Optimal Control Model. The effects on closed-loop performance of aircraft configuration (SAS-ON or SAS-OFF) and flight condition (hover or cruise) and of simulator motion cueing condition (fixed-base, moving platform or g-seat) were all analyzed. In addition, the interaction between these conditions and the level of pilot attention and/or skill (or training) was investigated by means of a sensitivity analysis in which we systematically varied a parameter of the OCM (the observation noise/signal ratio) which can be related to these pilot factors. The results indicate that motion cues could be very significant in the Harrier hover control task for the augmented (SAS-OFF) vehicle. For hover with the SAS-ON and for cruise flight, motion cues are predicted to be, at best, of marginal utility for improving performance. The model results suggest that motion cues may be provided for these tasks by a g-seat with little loss in performance as compared to using platform motion. However, the assumptions underlying the g-seat analysis have not been verified experimentally. Author (GRA)

N84-18210# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
MULTIVARIABLE CONTROL LAWS FOR THE AFTI/F-16 M.S. Thesis
A. F. BARFIELD Jul. 1983 337 p
(AD-A135870; AFIT/GE/EE/83S-4) Avail: NTIS HC A15/MF A01 CSCL 01C

Recently evolved multivariable design techniques are used to develop control laws for the AFTI/F-16. The techniques were developed by Professor Brian Porter of the University of Salford, England. In the study, designs are investigated to provide pilot control of vehicle rotational rates and accelerations. This line of inquiry is in contrast to the angle control concepts required in previous applications of these new techniques. A computer-aided design package called MULTI is used in refining the control laws to the preliminary design stage. It proves to be invaluable. An aircraft model is developed in state space form for the AFTI vehicle from linearized aerodynamic data. AFTI is equipped with additional control surfaces to provide Direct Force (CCV) control. Major emphasis is placed on the ability to properly blend CCV and conventional control capabilities for combat maneuvering. GRA

N84-18211# Aeronautical Research Labs., Melbourne (Australia).
THE CUMULATIVE EXCEEDANCE DISTRIBUTION FOR ACCELERATIONS DUE TO TURBULENCE ENCOUNTERED BY A CT/4A AIR TRAINER
D. J. SHERMAN Aug. 1983 21 p
(AD-A135640; ARL/STRUC-TM-364) Avail: NTIS HC A02/MF A01 CSCL 01A

A gust load spectrum is estimated for a CT/4A Airtrainer. The spectrum will be used in the specification of a loading sequence for a fatigue test. The accuracy of the estimation method is tested by comparing observed and predicted gust load spectra for the Aero-commander 680. Author (GRA)

N84-18212# National Aerospace Lab., Amsterdam (Netherlands). Flight Div.
LOW-SPEED HANDLING QUALITIES OF ADVANCED TRANSPORT AIRCRAFT: A COMPARISON OF GROUND-BASED AND IN-FLIGHT SIMULATOR EXPERIMENTS
M. F. C. VANGOOL 12 May 1982 60 p refs Revised
(Contract NIVR-1745; RB-RLD/80.042; RB-RLD/81.014)
(NLR-TR-82041-U-REV) Avail: NTIS HC A04/MF A01

Approaches and landings were carried out using an in-flight simulator to validate results of experiments carried out on a ground-based simulator, in which handling qualities of transport aircraft equipped with rate-command/attitude-hold flight control systems were investigated. Results indicate that general trends in ground-based and in-flight results are very similar, but air speed control is more difficult in-flight than ground-based, resulting in higher Cooper-Harper ratings for longitudinal handling qualities in-flight. Improvement in pilot opinion with increasing levels of maneuver enhancement observed ground-based is not as explicit in-flight. The air speed problem was investigated by introducing artificial stick force stability in the system through feedback of velocity error. Control improves slightly but pilot opinions differ considerably on the merits of this addition. Author (ESA)

N84-19357# Technische Hogeschool, Delft (Netherlands). Dept. of Aerospace Engineering.
LECTURE NOTES ON AIRPLANE STABILITY AND CONTROL 1, PART 1
O. H. GERLACH May 1983 268 p refs 2 Vol.
(VTH-LR-384-PT-1) Avail: NTIS HC A12/MF A01

Airplane aerodynamic moments, equilibrium, static stability, control characteristics in steady flight, and dynamic longitudinal and lateral stability are discussed. The aerodynamic center and moment about the aircraft of the wing with fuselage and nacelles; equilibrium in steady, symmetric straight flight; static longitudinal stability with stick free and fixed; longitudinal control in pull up maneuvers and steady turns; steady, asymmetric flight; and the equations of motion of an airplane are covered. Author (ESA)

N84-19358# Technische Hogeschool, Delft (Netherlands). Dept. of Aerospace Engineering.
LECTURE NOTES ON AIRPLANE STABILITY AND CONTROL 1, PART 2
O. H. GERLACH May 1983 268 p refs 2 Vol.
(VTH-LR-384-PT-2) Avail: NTIS HC A12/MF A01

Airplane aerodynamic moments, equilibrium, static stability, control characteristics in steady flight, and dynamic longitudinal and lateral stability are discussed. The aerodynamic center and moment about the aircraft of the wing with fuselage and nacelles; equilibrium in steady, symmetric straight flight; static longitudinal stability with stick free and fixed; longitudinal control in pull up maneuvers and steady turns; steady, asymmetric flight; and the equations of motion of an airplane are covered. Author (ESA)

09

RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tube facilities; and engine test blocks.

A84-24176
AERODYNAMIC TESTING CONFERENCE, 13TH, SAN DIEGO, CA, MARCH 5-7, 1984, TECHNICAL PAPERS
Conference sponsored by the American Institute of Aeronautics and Astronautics. New York, American Institute of Aeronautics and Astronautics, 1984, 346 p.

Various topics on aerodynamic testing are addressed. The subjects considered include: aeropropulsion systems test facility; real-time engine testing; transport configuration wind tunnel test

with engine simulation; civil turbofan propulsion system integration studies using powered testing techniques; dynamic measurements in the settling chamber of a transonic cryogenic tunnel; aerodynamic and propulsion test unit with vitiated air heater; subscale testing of an ice suppression system for Space Shuttle launches. Also discussed are: dynamic flow quality measurements in a low-turbulence pressure tunnel; data acquisition and reduction techniques for a solar collector pressure test; application of adaptive wall to high-lift subsonic aerodynamic testing; wind tunnel tests on a high-performance low-Reynolds number airfoil; development and calibration of miniature Mach/flow-angularity probes; pressure records analysis in an unsteady expansion wave; and a new concept for exhaust diffusers of altitude test cells. C.D.

A84-24177*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

INITIAL RESEARCH PROGRAM FOR THE NATIONAL TRANSONIC FACILITY

B. B. GLOSS (NASA, Langley Research Center, Hampton, VA) IN: Aerodynamic Testing Conference, 13th, San Diego, CA, March 5-7, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 1-11.
(AIAA PAPER 84-0585)

The construction and checkout of the National Transonic Facility (NTF) have been completed, and detailed calibration is now in progress. The initial NTF research program covers a wide range of study areas falling into three major elements: (1) the assessment of Reynolds number sensitivities for a broad range of configurations and flow phenomena; (2) validation of the ability of NTF to simulate full-scale aerodynamics; and (3) the development of test techniques for improved test simulations in existing wind tunnels. This paper, therefore, is a status report on these various elements of the initial NTF research program. Author

A84-24178*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

CRYOGENIC WIND-TUNNEL MODEL TECHNOLOGY DEVELOPMENT ACTIVITIES AT THE NASA LANGLEY RESEARCH CENTER

C. P. YOUNG, JR., J. F. BRADSHAW, H. F. RUSH, JR., J. W. WALLACE, and V. E. WATKINS, JR. (NASA, Langley Research Center, Systems Engineering Div., Hampton, VA) IN: Aerodynamic Testing Conference, 13th, San Diego, CA, March 5-7, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 12-29. refs
(AIAA PAPER 84-0586)

This paper summarizes the current cryogenic wind-tunnel model technology development activities at the NASA Langley Research Center. These research and development activities are being conducted in support of the design and fabrication of models for the new National Transonic Facility (NTF). The scope and current status of major research and development work is described and where available, data are presented from various investigations conducted to date. In addition, design and fabrication experience for existing developmental models to be tested in the NTF is discussed. Author

A84-24179#

DETAILED FLOW DIRECTION MEASUREMENTS IN A TRANSONIC TEST SECTION

D. W. HERGERT and R. L. BENGELINK (Boeing Commercial Airplane Co., Seattle, WA) IN: Aerodynamic Testing Conference, 13th, San Diego, CA, March 5-7, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 30-37. refs
(AIAA PAPER 84-0587)

A flow field survey mechanism has been developed by the Boeing Aerodynamic Laboratory to allow detailed measurements of the local flow field in the 8 x 12 ft slotted test section of the Boeing Transonic Wind Tunnel. Data acquired earlier with several small survey mechanisms will be compared with that obtained with this new survey system. This system has the capability of surveying the entire working area of the test section. Vector representations of typical measured flow fields at several tunnel stations and for two different test section configurations will be shown. Author

A84-24181#

THE AEROPROPULSION SYSTEMS TEST FACILITY - AN OPPORTUNITY FOR IMPROVEMENTS IN AIRCRAFT PROPULSION DEVELOPMENT

J. G. MITCHELL (USAF, Arnold Engineering Development Center, Arnold Air Force Station, TN) IN: Aerodynamic Testing Conference, 13th, San Diego, CA, March 5-7, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 46-56.
(AIAA PAPER 84-0590)

Facility construction progress on the Aeropropulsion Systems Test Facility (ASTF) are updated, early test requirements which led to the identification of the ASTF performance criteria are summarized, and the test capability is reevaluated in the context of aircraft propulsion system test needs for the future. How well test requirements for 1985 and beyond have been anticipated is assessed, and the fitness of the facilities for satisfying critical test needs is considered. The cost of testing in ASTF is discussed, and the ASTF development schedule is presented. C.D.

A84-24182#

REAL-TIME ENGINE TESTING

J. R. RICKARD (USAF, Arnold Engineering Development Center, Arnold Air Force Station, TN) IN: Aerodynamic Testing Conference, 13th, San Diego, CA, March 5-7, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 57-64. refs
(AIAA PAPER 84-0591)

Real-time testing at the soon-to-be-completed Aeropropulsion Systems Test Facility (ASTF) is considered. The meaning of 'real time' is addressed from the standpoint of control theory and communications theory, and the differences between RTT and conventional testing are discussed. The philosophy of hardware, software, and operator roles implied by RTT is summarized, and the implementation of RTT is discussed in terms of the nature of the product, the process response time, the stored energy available, the uniqueness of the plant, and the segmentation of the capability. The costs of RTT are addressed, and user expectations of ASTF are enumerated and discussed in terms of the limitations that apply. C.D.

A84-24183#

TRANSPORT CONFIGURATION WIND TUNNEL TESTS WITH ENGINE SIMULATION

B. EWALD (Darmstadt, Technische Hochschule, Darmstadt, West Germany) IN: Aerodynamic Testing Conference, 13th, San Diego, CA, March 5-7, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 65-73. refs
(AIAA PAPER 84-0592)

The design, calibration, and operational experiences of the balance/air bridge combination of a large-scale complete Airbus configuration model for low-speed tests in the German-Dutch wind tunnel are described. The model tests are summarized, and accuracy problems occurring in the tests are briefly considered along with the internal balance design. The air bridge specifications, principles, and design are addressed. The calibration of the balance/air bridge combination is considered, including the calibration matrix and pressure and temperature effects. Advanced air bridge designs are briefly addressed. C.D.

A84-24185#
A SOLUTION FOR AERO-ACOUSTIC INDUCED VIBRATIONS ORIGINATING IN A TURBOFAN ENGINE TEST CELL
R. A. DICKMAN, H. W. HEHMANN, W. HOELMER (General Electric Co., Aircraft Engine Business Group, Cincinnati, OH), and R. J. FREULER (Ohio State University, Columbus, OH) IN: Aerodynamic Testing Conference, 13th, San Diego, CA, March 5-7, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 99-108.
(AIAA PAPER 84-0594)

Simple proof-of-concept, aero-acoustic scale model tests were conducted to identify practical solutions for reducing exhaust jet noise emanating from a General Electric turbofan test facility at Strother, Kansas. The exhaust stack flow characteristics were believed to be responsible for unacceptable vibrations of a lightweight roof of an adjacent building. Scale model configurations of exhaust stack flow modifiers were chosen, based both on anticipated aero-acoustic effectiveness and full scale ease of implementation. Several of the test schemes exhibited noise reduction characteristics deemed acceptable. At the low frequencies of interest, reductions of greater than 20 dB in sound pressure levels were measured. Full scale implementation of a scheme that is both aero-acoustically effective and simple in mechanical concept has been carried out at Strother, Kansas. Preliminary sound pressure level and resultant building vibration data indicate that a satisfactory solution has been found. Author

A84-24186*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A STUDY OF DYNAMIC MEASUREMENTS MADE IN THE SETTLING CHAMBER OF THE LANGLEY 0.3-METER TRANSONIC CRYOGENIC TUNNEL
C. B. JOHNSON and P. C. STAINBACK (NASA, Langley Research Center, Transonic Aerodynamics Div., Hampton, VA) IN: Aerodynamic Testing Conference, 13th, San Diego, CA, March 5-7, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 109-119. refs
(AIAA PAPER 84-0596)

Tests have been conducted in a cryogenic wind tunnel settling chamber using a fast response instrumentation to measure the possible existence of temperature fronts due to a sudden or step change in the rate of liquid nitrogen injection into the circuit. No indications of such fronts were obtained using three different techniques to change the rate of nitrogen injection. The normalized pressure and velocity fluctuations at two total temperatures and over a large range of Mach numbers and Reynolds numbers were about 2 x 10 to the -7th to 2 x 10 to the -6th and about 1.8 to 3 percent, respectively. There was no evidence of liquid nitrogen droplets in the flow down to a total temperature of 140 K. The pressure fluctuation power spectra from a pressure transducer correlated with the fan blade passage through the eighth harmonic of the fundamental frequency. C.D.

A84-24187*# Old Dominion Coll., Norfolk, Va.
INVESTIGATION OF SIDEWALL BOUNDARY LAYER REMOVAL EFFECTS ON TWO DIFFERENT CHORD AIRFOIL MODELS IN THE LANGLEY 0.3-METER TRANSONIC CRYOGENIC TUNNEL
A. V. MURTHY (Old Dominion University, Norfolk, VA), C. B. JOHNSON, E. J. RAY (NASA, Langley Research Center, Transonic Aerodynamics Div., Hampton, VA), and E. STANEWSKY (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen, West Germany) IN: Aerodynamic Testing Conference, 13th, San Diego, CA, March 5-7, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 120-133. refs
(AIAA PAPER 84-0598)

An investigation was carried out on two CAST 10-2 airfoil models with chords of 3 in. and 6 in. To evaluate the extent of sidewall influence on airfoil tests at transonic Mach numbers. The tests were conducted in the Langley 0.3-m Transonic Cryogenic Tunnel two-dimensional test section equipped with an upstream sidewall boundary layer removal system which reduces the boundary layer displacement thickness to about 1 percent of model halfspan from an initial 2 percent without boundary layer removal. Test results have shown the changes in the location of the shock on the upper surface of the airfoil to be about the same for both models with and without sidewall boundary layer removal. Even though large differences were noted in the high lift characteristics of the two models, the sidewall boundary layer removal had little effect on the differences. These tests also served to validate the boundary layer removal technique and the associated Mach number correction required with upstream boundary layer removal.
Author

A84-24188*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
WALL PRESSURE MEASUREMENTS FOR THREE-DIMENSIONAL TRANSONIC TESTS
W. G. SEWALL (NASA, Langley Research Center, Hampton, VA) IN: Aerodynamic Testing Conference, 13th, San Diego, CA, March 5-7, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 134-139. refs
(AIAA PAPER 84-0599)

An experiment is described that provides input data for wind-tunnel wall interference assessment methods that are based on test-section wall pressure distributions. Wall pressures have been measured along orifice rows on the test-section walls during longitudinal force tests on two model sizes of the same configuration. These data were acquired at Mach numbers between 0.60 and 0.90 in a small, atmospheric transonic wind tunnel. A sample of the data and a discussion of results are presented.
Author

A84-24189#
A SIGNIFICANT IMPROVEMENT OF AN AIR SUPPLY/BALANCE CROSS-OVER SYSTEM
C. CATALANOTTO and R. F. JARVIS (Grumman Aerospace Corp., Bethpage, NY) IN: Aerodynamic Testing Conference, 13th, San Diego, CA, March 5-7, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 140-146.
(AIAA PAPER 84-0600)

Application of the NASA-LaRC Air Sting System to an 11.36 percent scale powered model of the Grumman Design 698 Twin Tilt-Nacelle V/STOL configuration is described. During in-situ check loading of the V/STOL model three balance force measuring system, large balance-to-balance moment interactions were experienced. A significant reduction in these interactions was realized by installing a bellows in the Air Sting System. A description of the NASA Air Sting is given and the specific application to the Grumman V/STOL model and its three balance force measuring system is described. Conclusions and recommendations are offered for determining balance data reduction sensitivities from in-place or laboratory calibrations. Author

A84-24190*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
MODIFICATION OF NASA LANGLEY 8 FOOT HIGH TEMPERATURE TUNNEL TO PROVIDE A UNIQUE NATIONAL RESEARCH FACILITY FOR HYPERSONIC AIR-BREATHING PROPULSION SYSTEMS
H. N. KELLY and A. R. WIETING (NASA, Langley Research Center, Loads and Aeroelasticity Div., Hampton, VA) IN: Aerodynamic Testing Conference, 13th, San Diego, CA, March 5-7, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 147-154. refs
(AIAA PAPER 84-0602)

A planned modification of the NASA Langley 8-Foot High Temperature Tunnel to make it a unique national research facility for hypersonic air-breathing propulsion systems is described, and some of the ongoing supporting research for that modification is discussed. The modification involves: (1) the addition of an oxygen-enrichment system which will allow the methane-air combustion-heated test stream to simulate air for propulsion testing; and (2) supplemental nozzles to expand the test simulation capability from the current nominal Mach number to 7.0 include

Mach numbers 3.0, 4.5, and 5.0. Detailed design of the modifications is currently underway and the modified facility is scheduled to be available for tests of large scale propulsion systems by mid 1988. Author

A84-24192#

DEMONSTRATED PERFORMANCE CAPABILITIES OF THE AERODYNAMIC AND PROPULSION TEST UNIT (APTU) WITH A VITIATED AIR HEATER

D. W. STALLINGS and R. H. BURT (Calspan Field Services, Inc., Arnold Air Force Station, TN) IN: Aerodynamic Testing Conference, 13th, San Diego, CA, March 5-7, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 163-170.

(AIAA PAPER 84-0605)

The Aerodynamic and Propulsion Test Unit (APTU) at Arnold Engineering Development Center is described and its demonstrated and predicted performance, its test capabilities other than ramjet engine testing, and planned improvements are discussed. The facility differs from most other wind tunnels of its type in its use of a vitiated air heater for increasing the temperature of the airstream and in its completely computer-controlled operation. Block diagrams of the facility flow schematic, the mass flow control (MFC) software, APTU plant system, and MFC simulator are shown along with diagrams of the whole facility, the stilling chamber, and the heater assembly. Data on stilling chamber pressure and temperature, the APTU operating envelope, facility run time, burner efficiency, vitiation effects on specific heat ratios, and aerothermal test facilities are presented. C.D.

A84-24199*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.

AN EXPERIMENTAL STUDY OF HIGH CONTRACTION RATIO, SUBSONIC WIND TUNNEL INLETS

M. J. CAYLOR (NASA, Kennedy Space Center, Cocoa Beach, FL) and S. M. BATILL (Notre Dame, University, Notre Dame, IN) IN: Aerodynamic Testing Conference, 13th, San Diego, CA, March 5-7, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 236-245. Research supported by the University of Notre Dame. refs

(Contract F33615-81-K-3008)

(AIAA PAPER 84-0618)

The inlet or contraction section has significant impact on the performance and operating characteristics of any subsonic wind tunnel. Previous experimental studies have been conducted to examine specific aspects of inlet performance and design. This work builds on this earlier experience by performing a comprehensive experimental analysis of a member of a family of high contraction ratio inlets used on indraft type wind tunnels. Quantitative flow field measurements were made using wall static ports, a five-hole pressure probe, and a hot wire anemometry system. Smoke flow visualization techniques were used to examine the inlet flow in a more qualitative manner and to correlate with quantitative measurements. This experimental investigation has provided insight into some of the many problems associated with inlet flows. Author

A84-24201*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

DYNAMIC FLOW QUALITY MEASUREMENTS IN THE LANGLEY LOW TURBULENCE PRESSURE TUNNEL

P. C. STAINBACK and F. K. OWEN (NASA, Langley Research Center, Hampton, VA) IN: Aerodynamic Testing Conference, 13th, San Diego, CA, March 5-7, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 257-265. refs

(AIAA PAPER 84-0621)

The results of tests to measure the disturbance levels across the cooler, screens, and nozzle in the test section of the rehabilitated Langley Research Center Low Turbulence Pressure Tunnel are reported and discussed. The velocity fluctuations measured upstream and downstream of the cooler were approximately equal and ranged from 5 to 15 percent. The attenuation of the measured velocity fluctuations across the screen agreed with predictions from Dryden's (1949) theory. Velocity fluctuations in the test section ranged from 0.025 percent at Mach 0.05 to 0.3 percent at Mach 0.2. Pressure fluctuations at the test section walls agreed with previous measurements made under a turbulent boundary. The autocorrelation functions indicated that there were large reductions in the integral scale of turbulence across the cooler and screens. The spectra measured upstream and downstream of the cooler were mostly broadband. C.D.

A84-24203#

THREE-DIMENSIONAL TESTING IN A FLEXIBLE-WALL WIND TUNNEL

D. J. HARNEY (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, OH) IN: Aerodynamic Testing Conference, 13th, San Diego, CA, March 5-7, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 276-283. refs

(AIAA PAPER 84-0623)

A square 9-inch wind tunnel with solid sidewalls and flexible upper and lower rod walls capable of three-dimensional contouring was used to test an axisymmetric and a winged lifting model at M = 0.50 to 0.95. The simple, direct analytical method for wall contouring uses the model geometry for solid blockage and iterative model force data to adapt for lift and for wake blockage. Solid sidewall effects and the convergence of the adaptation scheme are evaluated. Linear and nonlinear theory for solid blockage is compared. Interesting comparisons are also made between two-dimensional and three-dimensional wall contouring. Author

A84-24204#

APPLICATION OF THE ADAPTIVE WALL TO HIGH-LIFT SUBSONIC AERODYNAMIC TESTING - AN ENGINEERING EVALUATION

R. F. STARR and M. O. VARNER (Sverdrup Technology, Inc., Tullahoma, TN) IN: Aerodynamic Testing Conference, 13th, San Diego, CA, March 5-7, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 284-291. refs

(AIAA PAPER 84-0626)

The streamline curvature around high-lift airfoils at low-speed conditions is reviewed to assess adaptive wall requirements for a three-dimensional test section. High-lift flapped airfoil cases with large flow separation zones and an extreme blown-flap airfoil are considered. An engineering configuration for the adaptive wall test section, accounting for model to tunnel span, wind chord to tunnel height, lifting area to test section cross sectional area, and test section to wing chord length ratio, is developed. The chosen multielement adaptive wall is shown to meet deflection and radius of curvature requirements for the evaluated cases of extreme lift and low advance ratio. Test sections of cross-sectional area about one quarter that of existing moderate-lift, low-speed test tunnels can be utilized without incurring blockage-induced errors. Preliminary results indicate that such errors can be minimized even with flow impingement at the test section wall. C.D.

A84-24205*# Virginia Associated Research Center, Newport News.

A SLOTTED TEST SECTION NUMERICAL MODEL FOR INTERFERENCE ASSESSMENT

W. B. KEMP, JR. (Virginia Associated Research Campus, Newport News, VA) IN: Aerodynamic Testing Conference, 13th, San Diego, CA, March 5-7, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 292-299. refs

(Contract NCC1-69)

(AIAA PAPER 84-0627)

A numerical model of a slotted wind tunnel test section, intended for use with sparsely measured wall pressures in a wall interference assessment procedure, is described. The numerical model includes a discrete finite length wall slot representation and accounts for the nonlinear effects of the dynamic pressure of the slot outflow jet and of the low energy of slot inflow air. By using th numerical model in a wall interference prediction mode, it is demonstrated

that accounting for slot discreteness is important in interpreting wall pressures measured between slots, and that accounting for finite slot length and nonlinear effects in the slot boundary condition can yield significant departures from the wall interference predicted using the classical linear homogeneous infinite-length wall representation. Author

A84-24210*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

A NEW CONCEPT FOR EXHAUST DIFFUSERS OF ALTITUDE TEST CELLS

P. G. PARIKH and V. SAROHIA (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) IN: Aerodynamic Testing Conference, 13th, San Diego, CA, March 5-7, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 335-342. Navy-sponsored research. (AIAA PAPER 84-0634)

A new exhaust diffuser concept for jet engine altitude test cells which greatly reduces operating power and cost requirements for exhausters is discussed. The concept utilizes the capture duct as an efficient diffuser only, while evacuating the secondary air via a separate path using an auxiliary suction system. Implementation of the concept would reduce the peak exhauster power requirement during a TF-30 altitude test by 48 percent and the overall exhaust power cost of the test program by 41 percent. The design accommodates various engine sizes and can achieve optimum pressure recovery performance during both A/B and IRP modes of engine operation. The pressure recovery performance of the proposed exhaust diffusers does not deteriorate with increasing cooling air fraction. The disadvantages of the proposed scheme are: increased mechanical complexity of the extended variable geometry diffuser duct and the need for an auxiliary suction system for evacuating cell-cooling air. C.D.

A84-25201

ICIASF '83; INTERNATIONAL CONGRESS ON INSTRUMENTATION IN AEROSPACE SIMULATION FACILITIES, SAINT-LOUIS, HAUT-RHIN, FRANCE, SEPTEMBER 20, 1983, RECORD

New York, Institute of Electrical and Electronics Engineers, 1983, 310 p.

The visualization of separated flows is considered, along with the role of flow visualization as a diagnostic tool for Space Shuttle aero-analysis, the visualization of boundary layer transition on a cone with liquid crystals, concentration measurements with digital image processing, and the holographic streamer chamber. Attention is given to high-speed holography of remote objects in applications to ballistics, digital picture processing on high speed holograms, bubble dynamics studied with ultra high speed holocinematography, the holographic measurement of diesel sprays, the holographic optical element for aerospace application, and a fringe counting method for the measurement of rapid changes of refractive indices in gases. Other topics discussed are related to instrumentation requirements for wind tunnel testing, a piston model for the simulation of moving ionized gas layers interacting with microwaves, the role of laser velocimetry in fluid dynamics research, and a hot-wire method for high-intensity turbulent flows. G.R.

A84-25211

CONTROL OF TURBINE SIMULATORS FOR LOW SPEED WINDTUNNEL TESTS

R. SCHRAMM (Duits-Nederlandse Windtunnel, Noordoostpolder, Netherlands) IN: ICIASF '83; International Congress on Instrumentation in Aerospace Simulation Facilities, Saint-Louis, Haut-Rhin, France, September 20, 1983, Record . New York, Institute of Electrical and Electronics Engineers, 1983, p. 95-101.

The German-Dutch Wind Tunnel simulates jet and propeller engines in the models it tests by means of pneumatically driven Turbine Power Simulators or Air Turbine Motors. Attention is presently given to the control system employed by these devices, which exercises digital compressed air supply control. A computer simulation has been developed for the system's air flow, allowing control concept testing and modification without disturbing the system's hardware. The basing of the system on software to such an extent makes it highly flexible, and the tests indicate the digital controller's fulfilment of all aerodynamic requirements. O.C.

A84-25212

A DISTRIBUTED COMPUTER SYSTEM FOR CONTROL, DATA ACQUISITION AND PROCESSING IN A BLOWDOWN WIND TUNNEL

L. LOMAX (British Aerospace PLC, Aircraft Group, Preston, Lancs., England) IN: ICIASF '83; International Congress on Instrumentation in Aerospace Simulation Facilities, Saint-Louis, Haut-Rhin, France, September 20, 1983, Record . New York, Institute of Electrical and Electronics Engineers, 1983, p. 102-109.

A new Data Acquisition and Control System has been acquired for the 1.22 m High Speed Wind Tunnel facility at British Aerospace, Warton. This is a high speed blowdown tunnel with a run duration of up to 30 seconds. A distributed computer system has been built and commissioned, comprising of four processors. The data reduction and data processing requirements are satisfied by using a Digital Equipment Corporation (DEC) VAX 11/780. This is a high performance computer system based on 32 bit architecture. This processor, together with its associated peripherals, acts as host to the Data Acquisition and Control System. The system interfaces with the tunnel, model and controlled systems, and comprises three processors. These processors, Data Acquisition, Control, and Scan, are interconnected by specially designed Bus Windows which allows data to pass bi-directionally and asynchronously between the data bus of any two of the three processors. Author

A84-25213#

LOW PRESSURE MEASUREMENT TECHNIQUES IN A HYPERVELOCITY WIND TUNNEL

M. M. ROBERTS, C. FISCINA, and R. L. P. VOISINET (U.S. Navy, Naval Surface Weapons Center, Silver Spring, MD) IN: ICIASF '83; International Congress on Instrumentation in Aerospace Simulation Facilities, Saint-Louis, Haut-Rhin, France, September 20, 1983, Record . New York, Institute of Electrical and Electronics Engineers, 1983, p. 110-116. refs

A study of potential methods for measuring extremely low pressures (400 microHg, 0.008 psia) in the Naval Surface Weapons Center Hypervelocity Wind Tunnel 9 was undertaken. Candidate techniques were evaluated in terms of compatibility with wind tunnel models, accuracy, and response time. From the study, Microswitch Model 130 PC pressure transducers were selected for further evaluation and a detailed calibration of those transducers was performed to check linearity, hysteresis, sensitivity, and repeatability. The response time of the pressure measuring system was also considered including the effects of tubing length and diameter. Wind tunnel tests were conducted using a sphere-cone model instrumented with 24 transducers in Tunnel 9 at high altitude simulation conditions. Altitudes above 150,000 feet were simulated and static pressures in the range of 50 microHg to 3500 microHg were successfully measured with an accuracy of + or - 39 microHg. Author

A84-25215

EXPERIMENTAL DESIGN FOR CALIBRATION OF WIND TUNNEL BALANCES

I. SJORS (Flygtekniska Forsoksanstalten, Bromma, Sweden) IN: ICIASF '83; International Congress on Instrumentation in Aerospace Simulation Facilities, Saint-Louis, Haut-Rhin, France, September 20, 1983, Record . New York, Institute of Electrical and Electronics Engineers, 1983, p. 131-133.

The strategy for calibration of a multicomponent wind tunnel balance out of an optimized low number of observations is analyzed. During the development of the procedures used for calibration efforts have been made to achieve the most efficient experiment. The objective has been to obtain a good fitting mathematical model in a minimum amount of time spent for the data acquisition. A statistical design of the experiment based on a broad theoretical foundation is used. The benefits of factorial planning have been

used to develop an efficient plan for selecting independent variables (loads). Well established powerful methods for validation and analysis have been employed. Author

A84-25217

AERODYNAMIC BALANCE FOR HIGH ALTITUDE SIMULATION CHAMBER

J. ALLEGRE, M. RAFFIN (Societed'Etudes de Constructions et de Services pour Souffleries et Installations Aerothermo-dynamiques, Paris, France), and J.-C. LENGRAND (CNRS, Laboratoire d'Aerothermique, Meudon, Hauts-de-Seine, France) IN: ICIASF '83; International Congress on Instrumentation in Aerospace Simulation Facilities, Saint-Louis, Haut-Rhin, France, September 20, 1983, Record . New York, Institute of Electrical and Electronics Engineers, 1983, p. 141-144. Research supported by the Direction des Recherches, Etudes et Techniques.

A three component balance has been designed in order to provide force measurements related to plume impingement problems at high altitude conditions. For surfaces submitted to exhaust plume impingements, shear stress forces, pressure forces as well as force locations can be experimentally deduced from balance data. The paper includes a brief description of the balance, some preliminary force results in rarefied flow conditions, and comparisons between experimental data and theoretical predictions. Author

A84-25218

DETERMINATION OF NON-LINEAR LOADS ON OSCILLATING MODELS IN WIND TUNNELS

E. S. HANFF (National Research Council, Ottawa, Canada) IN: ICIASF '83; International Congress on Instrumentation in Aerospace Simulation Facilities, Saint-Louis, Haut-Rhin, France, September 20, 1983, Record . New York, Institute of Electrical and Electronics Engineers, 1983, p. 145-151. refs

Existing forced oscillation wind tunnel techniques are based on the assumption that the aerodynamic reactions induced by the motion of a model are linearly related to the motion. Although this assumption is probably correct under the small oscillation amplitudes normally used in such experiments, it is not acceptable in the presence of larger amplitudes where significant non linearities can be expected. A novel, more general technique, specifically developed to measure any alternating load - linear, non-linear or hysteretical - caused by the model motion is described. Preliminary wind tunnel tests have shown that these loads can indeed be determined by means of the technique, making it a useful tool for the study of a variety of non-linear aerodynamic phenomena. Author

A84-25219#

ASYMMETRIC BLOWING MODEL DESIGN AND TESTING

R. L. P. VOISINET, C. FISCINA, and E. HEDLUND (U.S. Navy, Naval Surface Weapons Center, Silver Spring, MD) IN: ICIASF '83; International Congress on Instrumentation in Aerospace Simulation Facilities, Saint-Louis, Haut-Rhin, France, September 20, 1983, Record . New York, Institute of Electrical and Electronics Engineers, 1983, p. 152-157.

The simulation of ablation processes in wind tunnel testing is usually accomplished by the injection of a gas through the porous skin of a wind tunnel model. Fabrication techniques for such models have traditionally been complex and expensive, using porous sintered metals, screens, or perforated sheets. A new porous material and model fabrication procedure are described. The technique is easily adaptable to many test configurations and uses a porous material which has a significantly improved porosity uniformity, is inexpensive, is easily machinable, and can be designed to provide accurate symmetric and asymmetric blowing distributions over model surfaces. Author

A84-25226*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

APPLICATION OF LASER ANEMOMETRY TO CRYOGENIC WIND TUNNELS

W. W. HUNTER, JR., W. C. HONAKER, and L. R. GARTRELL (NASA, Langley Research Center, Hampton, VA) IN: ICIASF '83; International Congress on Instrumentation in Aerospace Simulation Facilities, Saint-Louis, Haut-Rhin, France, September 20, 1983, Record . New York, Institute of Electrical and Electronics Engineers, 1983, p. 200-208. refs

The installation and tests conducted with the laser Doppler and transit anemometer in the 0.3-Meter Transonic Cryogenic Tunnel are described. Using residual particulates in the flow field, a series of free stream velocity measurements were conducted which agreed to within 1-percent of predicted values for a range of Mach numbers, 0.2 to 0.85, and temperatures, 100 to 250 K. Measurements about a shock wave provided an estimate of scattering particulate size of 4 microns or less. The particle concentration is approximately 3 x 10 to the 5th to 1.6 x 10 to the 6th/cu m. Necessary isolation of the plenum wall windows from ambient air with slightly positive pressure of dry nitrogen gas to prevent condensation on the window surface was achieved. This was accomplished through the use of large enclosures fixed to the tunnel wall. A second method used an additional sheet of thin plate glass to create the dry gas pocket next to the plenum window. The installation of a laser anemometer in the National Transonic Facility is examined. The laser transit anemometer has been tentatively selected for the initial entry because of its compact laser-optics package. Author

A84-25726*# Virginia Polytechnic Inst. and State Univ., Blacksburg.

DESIGN OF HIGH-REYNOLDS-NUMBER FLAT-PLATE EXPERIMENTS IN THE NTF

W. S. SARIC (Virginia Polytechnic Institute and State University, Blacksburg, VA) and J. B. PETERSON, JR. (NASA, Langley Research Center, Aerodynamics Branch, Hampton, VA) American Institute of Aeronautics and Astronautics, Aerodynamic Testing Conference, 13th, San Diego, CA, Mar. 5-7, 1984. 10 p. refs

(Contract NCC1-71)

(AIAA PAPER 84-0588)

The design of an experiment to measure skin friction and turbulent boundary-layer characteristics at Reynolds numbers exceeding one billion is described. The experiment will be conducted in a zero-pressure-gradient flow on a flat plate in the National Transonic Facility. The development of computational codes to analyze the aerodynamic loads and the blockage is documented. Novel instrumentationn techniques and models, designed to operate in cryogenic environments, are presented. Special problems associated with aerodynamic loads, surface finish, and hot-wire anemometers are discussed. Author

A84-25728*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

AERODYNAMIC CHARACTERISTICS OF THE 40- BY 80-/80- BY 120-FT WIND TUNNEL AT NASA-AMES RESEARCH CENTER

V. R. CORSIGLIA, L. E. OLSON, and M. D. FALARSKI (NASA, Ames Research Center, Moffett Field, CA) American Institute of Aeronautics and Astronautics, Aerodynamic Testing Conference, 13th, San Diego, CA, Mar. 5-7, 1984. 23 p. refs

(AIAA PAPER 84-0601)

The design and testing of vane sets and air-exchange inlet for the 40 x 80/80 x 120-ft wind tunnel at NASA Ames are reported. Boundary-layer analysis and 2D and 3D inviscid panel codes are employed in computer models of the system, and a 1/10-scale 2D facility and a 1/50-scale 3D model of the entire wind tunnel are used in experimental testing of the vane sets. The results are presented in graphs, photographs, drawings, and diagrams and discussed. Generally good agreement is found between the predicted and measured performance. T.K.

A84-25729*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

TWO-DIMENSIONAL WAKE CHARACTERISTICS OF INLET VANES FOR OPEN-CIRCUIT WIND TUNNELS

M. R. DUDLEY (NASA, Ames Research Center, Moffett Field, CA), G. UNNEVER (USAF, Wright-Patterson AFB, OH), and D. R. REGAN American Institute of Aeronautics and Astronautics, Aerodynamic Testing Conference, 13th, San Diego, CA, Mar. 5-7, 1984. 12 p. refs

(AIAA PAPER 84-0604)

This paper summarizes the near-field flow characteristics measured downstream of a half-scale two-dimensional wind-tunnel model of the inlet vanes designed for the National Full-Scale Facilities Complex at NASA Ames Research Center. Variations on this baseline were tested to determine how the downstream flow field is affected. Evaluations of the various configurations were made by the use of hot-wire surveys across the flow-field. These traverses yielded the properties of total pressure, boundary layers, and turbulence in the wake of the vanes. It was found that large variations in the flow field characteristics downstream of the vanes are achieved by the use of various arrangements of splitter vanes, vortex generators, screens, tail extensions, and honeycomb. Separation on the boat-tails of the vanes can be controlled and turbulence reduced by suitable combinations of screens or honeycomb or both. The penalties associated with each modification in terms of increased pressure loss are also presented. Author

A84-25732#

HIGH ALTITUDE MANEUVER CONTROL TEST IN THE NSWC HYPERVELOCITY TUNNEL

B. D. PRATS, J. A. F. HILL, M. A. METZGER (U.S. Navy, Naval Surface Weapons Center, Silver Spring, MD), and D. W. HARVEY (McDonnell Douglas Astronautics Co., Huntington Beach, CA) American Institute of Aeronautics and Astronautics, Aerodynamic Testing Conference, 13th, San Diego, CA, Mar. 5-7, 1984. 10 p.

(AIAA PAPER 84-0616)

An experimental simulation of high-performance missile interceptor vehicles which are controlled by large jets issuing laterally from the body was conducted in the NSWC Hypervelocity Wind Tunnel No. 9. The test program was conducted using a blunt bi-conic model with a thruster assembly that utilized gaseous nitrogen at high pressures to provide lateral thrust. Detailed surface pressure distributions were measured over the entire body and Schlieren flowfield photographs were obtained. Tests were conducted at Mach numbers of 10 and 14 and Reynolds numbers from 20 million to 150 thousand per foot. Run times were on the order of 0.7 seconds which allowed for continuous pitch sweeps from -15 to +15 degrees angle of attack. This paper describes the design, fabrication and operation of the thruster gas supply system and wind tunnel model, including a brief description of tunnel blockage effects, and presents the resulting pressure data. Author

A84-25733#

STATUS OF THREE-DIMENSIONAL ADAPTIVE-WALL TEST SECTION DEVELOPMENT AT AEDC

R. L. PARKER, JR. and J. C. ERICKSON, JR. (Calspan Field Services, Inc., Arnold Air Force Station, TN) American Institute of Aeronautics and Astronautics, Aerodynamic Testing Conference, 13th, San Diego, CA, Mar. 5-7, 1984. 10 p. refs

(AIAA PAPER 84-0624)

A three-dimensional, transonic, porous-adaptive-wall test section has been assembled and tested at Arnold Engineering Development Center (AEDC). Description of the components of the fully automated, computer-controlled, closed-loop test section is given. A preliminary calibration and evaluation program was completed recently for the test section which is installed in the AEDC Aerodynamic Wind Tunnel (1T). The automated systems were exercised by using the adaptive technique to establish discrete, uniform Mach numbers within the test section from arbitrary nonuniform initial conditions. Finally, a representative transonic model was installed and adaptive experiments commenced. Repeatable, converged solutions were obtained in the adaptive mode of operation; however, the solutions did not agree exactly with wall-interference-free reference data for the test model. Extensive analysis of the results revealed that there was an error in the exterior computational code and that errors were being introduced by the interface flow-variable measurement system. These errors caused the adaptive-wall test section to adjust itself to erroneous interior-flow conditions. Author

A84-25996#

FREE FLIGHT METHOD IN HYPERSONIC IMPULSE TYPE TUNNELS FOR STATIC AND DYNAMIC STABILITY STUDY

J. MA, Z. TANG, and X. ZHANG (Chinese Academy of Sciences, Mechanics Institute, Beijing, People's Republic of China) Acta Aerodynamica Sinica, no. 4, 1983, p. 77-85. In Chinese, with abstract in English. refs

The paper describes the free flight testing technique in hypersonic impulse type tunnels for stability study. The experiments were carried out, as a practical example, in a shock tunnel at Mach 9.6 and in a gun tunnel at Mach 9.9. About two and five cycles of angular motion of a 10 deg-sharpened cone were obtained in the two facilities respectively. The data were recorded by 2D-high speed photography and then reduced according to the tricycle theory and parameter differential method given by G. T. Chapman and D. B. Kirk (1970). The results show that the pitch damp of a sharpened cone model decreases slightly with increasing cone angle and that the damp varies almost linearly with the location of center of gravity. The dynamic stability derivatives obtained from the gun tunnel agree fairly with those from ballistic ranges in similar conditions. Author

A84-25997#

AN EXPERIMENTAL INVESTIGATION OF TRANSONIC WIND TUNNEL WALL INTERFERENCE EFFECT ON AIRFOIL TESTING

B. RONG and Y. HUANG (Nanjing Aeronautical Institute, Nanjing, People's Republic of China) Acta Aerodynamica Sinica, no. 4, 1983, p. 86-93. In Chinese, with abstract in English. refs

Two dimensional airfoil NACA0012 transonic testings have been conducted in a NH-1 transonic wind tunnel. The results show that the variation of both wall porosity and model size has a marked effect on the static pressure at reference points of the plenum chamber, and that the variation of wall porosity alone has a considerable effect on the surface pressure distribution of the airfoil. At alpha = 0 deg under supercritical conditions, as tau changes from 6 to 0.5 percent, the shock wave on the upper surface of the airfoil moves aft about 20 percent of the chord length. When tau = 4 the results approximate blockage interference-free data, and when alpha = 1 deg and M(infinity) = 0.759, the optimal wall porosity approximating freedom from wall interference is four. Author

A84-26370

DETERMINATION OF THE ABSOLUTE HUMIDITY OF AIR USING A LAVAL NOZZLE

W. H. STAHL Zeitschrift fuer Flugwissenschaften und Weltraumforschung (ISSN 0342-068X), vol. 8, Jan.-Feb. 1984, p. 45-49. refs

The flow of moist air in a Laval nozzle is investigated experimentally in terms of the disturbances caused by condensation shocks. The variation in the state variables, such as pressure, due to condensation depends on the absolute humidity of the airstream. It is considered possible to exploit such dependence to determine absolute humidity from pressure measurements. To this end, static pressures are measured along the wall of a Laval half-nozzle as a function of the absolute humidity and for various total temperatures of the air. It is found that a Laval nozzle can be used to determine even small absolute humidities rapidly and with sufficient accuracy using pressure measurements. The method might be used for wind tunnel humidity measurements. Author

N84-18214*# National Aeronautics and Space Administration, Washington, D. C.
REMARKS ON THE LAYOUT OF THE SUBSONIC FREE JET WIND TUNNELS
J. D. VAGT Nov. 1983 12 p refs Transl. into ENGLISH from Z. fuer Flugwiss. (West Germany), v. 21, no. 5, 1973 p 159-162 Original language document was announced as A73-33266
(Contract NASW-3541)
(NASA-TM-77326; NAS 1.15:77326) Avail: NTIS HC A02/MF A01 CSCL 14B

By means of a recently installed wind tunnel with a circular free jet, it is shown that requirements concerning the flow parameters (e.g., uniform velocity profile and uniform and low turbulence level in the nozzle exit) can be easily and at moderate expenses fulfilled without changing the settling chamber and the nozzle itself. The installations in the settling chamber are adjustable. The structure is not limited to settling chambers with a circular cross section. Author

N84-18215# National Aerospace Lab., Tokyo (Japan). Aerodynamics Div.
RESULTS OF THE TEST ON ONERA CALIBRATION MODEL M5 IN NAL 2M X 2M TRANSONIC WIND TUNNEL
Aug. 1983 25 p refs
(NAL-TR-774T; ISSN-0389-4010) Avail: NTIS HC A02/MF A01

The ONERA calibration model M5 was duplicated to be tested in the NAL 2m X 2m transonic wind tunnel. The general trend of the results with respect to Mach number as well as Reynolds number agreed with those obtained in other tunnels. The cause of minor discrepancies was studied in the light of flow characteristics on the model. Precision of model production, and repeatability of force and pressure measurement were also investigated. Author

N84-18216# Northrop Corp., Hawthorne, Calif.
INTEGRATION OF FLIGHT TEST DATA INTO A REAL-TIME SIMULATION
M. W. TAPPAN, T. C. DULL, C. A. HUGHES, and G. M. TADYCH 1984 12 p
Avail: NTIS HC A02/MF A01

A capability which allows for integration of flight test results into the simulation process was established. This capability consists of an automated comparison of flight test and simulation data and, if warranted, the identifications required to improve the simulation's representation of the air-vehicle. This process demonstrated the ability to efficiently integrate flight test results into a real-time simulation for validation and enhancement of the simulated air-vehicle's characteristics. Author

N84-18217# Calspan Field Services, Inc., Arnold Air Force Station, Tenn.
CAPTIVE TRAJECTORY SYSTEM TEST PLANNING INFORMATION FOR AEDC SUPERSONIC WIND TUNNEL (A) AND HYPERSONIC WIND TUNNELS (B) AND (C) Final Report, 1 Oct. 1981 - 30 Sep. 1982
T. D. BUCHANAN and W. A. CROSBY Arnold AFS, Tenn. AEDC Dec. 1983 48 p
(AD-A136439; AEDC-TR-83-40) Avail: NTIS HC A03/MF A01 CSCL 20D

Normally in the development of flight vehicle systems, the staging characteristics have to be obtained experimentally. This report briefly describes the specialized methods used in wind tunnel tests at the Arnold Engineering Development Center in simulating the staging process. The capabilities of the mechanisms and the precision to which the data can be obtained are presented, along with descriptions of typical tests. Author (GRA)

N84-18218# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
COMPARISON OF THE LONGITUDINAL FLYING QUALITIES OF AN OPTIMAL PILOT MODEL, A GROUND-BASED SIMULATOR AND AN AIRBORNE SIMULATOR M.S. Thesis
J. M. PAYNE Sep. 1983 116 p
(AD-A135853; AFIT/GAE/AA/83S-5) Avail: NTIS HC A06/MF A01 CSCL 14B

This thesis presents a comparison of the longitudinal flying qualities as predicted by an analytical computer model, a ground-based simulator, and an airborne simulator. The comparison was designed to correlate the results and judge whether ground tests could forecast airborne results. Project tests were conducted using the Optimal Pilot Single Axis Control Task (OPSACT) computer program, the ground based Simulator for Aircraft Flight Test and Development (SAFTD), and the variable stability USAF NT-33A aircraft. The objective of this evaluation was to determine and compare the pilot performance in the three cases, and to determine and compare the pilot ratings in the simulators. Secondary objectives included an investigation of the effects of different load factors in the two simulators and the effects of visual and motion cues in the NT-33A. GRA

N84-18219# Air Force Human Resources Lab., Brooks AFB, Tex. Operations Training Div.
SURFACE-ATTACK MISSION SIMULATION: PRELIMINARY SCENARIO EVALUATION Interim Report, Nov. 1980 - Oct. 1981
E. L. MARTIN and I. G. LIDDERDALE Nov. 1983 32 p
(Contract AF PROJ. 1123)
(AD-A135868; AFHRL-TR-83-21) Avail: NTIS HC A03/MF A01 CSCL 05I

A part-task deep/strike interdiction scenario was developed for flight simulation application on the Advanced Simulator for Pilot Training (ASPT) configured as an F-16 aircraft. The scenario included visual target-area penetration, attack, and egress. The target was a storage building located in a valley surrounded by mountains terrain. The target area was defended by two threat sites containing surface-to-air missiles (SAMs) and quad-mounted antiaircraft artillery (AAA) and one AAA site co-located with the target building. GRA

N84-18220# Hughes Aircraft Co., Long Beach, Calif.
COST AND PERFORMANCE ANALYSIS OF VISUAL AND SENSOR SIMULATION SYSTEMS USING DEFENSE MAPPING AGENCY DATA BASES Final Report, Aug. 1982 - Oct. 1983
M. L. NACK, A. ROSMAN, C. YANG, and E. HASELTINE Wright-Patterson AFB, Ohio AFWAL Oct. 1983 88 p
(Contract F33615-82-C-1785; AF PROJ. 2303)
(AD-A135955; AFWAL-TR-83-1184) Avail: NTIS HC A05/MF A01 CSCL 09B

This report evaluates the cost and performance of real-time visual and sensor simulation systems. The sensors included are infrared, radar, and low light level TV. The missions to be simulated are the air to ground attack missions of the Air Force Pave Pillar program. Author (GRA)

N84-18221# Naval Postgraduate School, Monterey, Calif.
DEVELOPMENT OF A FLIGHT SIMULATION CONCEPT AND AERODYNAMIC BUILDUP FOR INVESTIGATION OF DEPARTURE PREVENTION SYSTEMS IN TACTICAL AIRCRAFT M.S. Thesis
A. L. RAITHEL, III Sep. 1983 88 p
(AD-A136182) Avail: NTIS HC A05/MF A01 CSCL 01C

The conceptual development of a computer flight simulation for design, testing and analysis of departure prevention systems, simulation capability and programming are discussed, along with required research material and data. A description is given of the aerodynamic buildup program written for incorporation in the simulation, including the aerodynamic equations of the model base aircraft, sample program statements and output. GRA

N84-18222# Army Engineer Waterways Experiment Station, Vicksburg, Miss. Geotechnical Lab.
INVESTIGATION OF THE FAA OVERLAY DESIGN PROCEDURES FOR RIGID PAVEMENTS Final Report on phase 1
Y. T. CHOU Aug. 1983 158 p
(Contract DTFA01-81-Y-10523)
(AD-A135317; DOT/FAA/PM-83/22) Avail: NTIS HC A08/MF A01 CSCL 13B

The existing FAA overlay design procedures and their history of development are first briefly presented in the report. This is followed by a detailed summary of consultant's reports, which include the identification of deficiencies in the existing procedures with suggested improvements. Immediate improvements to several items in the existing procedures are presented for use as new paragraphs and modification of existing paragraphs in the FAA Advisory Circular. Items to be addressed in a Phase II continuation study are presented. Author (GRA)

N84-18223# Virginia Polytechnic Inst. and State Univ., Blacksburg. Coll. of Engineering.
DESIGN AND EVALUATION OF A PULSATING-FLOW WIND TUNNEL
A. TAVAKOLI, B. K. KIM, G. J. BORELL, T. E. DILLER, and D. P. TELIONIS May 1983 180 p refs
(Contract DE-AS05-82ER-12022)
(PB84-116086; VPI-E-83-41) Avail: NTIS HC A09/MF A01 CSCL 14B

A wind tunnel was designed and built to produce pulsating flow. The pulsation was achieved by a series of shutters placed upstream of the settling chamber inlet. The shutters were rotated with the same angular velocity, but a variety of phase differences were used to affect the velocity wave form in the test section. The system was optimized to obtain nearly sinusoidal velocity waveforms with the highest obtainable amplitudes over the frequency range of 3.4 to 39.5 Hz. Velocity and pressure waveforms are given for different shutters, settings and conditions. GRA

N84-19359*# National Aeronautics and Space Administration, Washington, D. C.
USE OF ADAPTIVE WALLS IN 2D TESTS
J. P. ARCHAMBAUD and J. P. CHEVALLIER Feb. 1984 35 p refs Transl. into ENGLISH from AGARD Conf. on Wall Interference in Wind Tunnels (France), AGARD-CP-335, Sep. 1982 14 p Conf. held in Neuilly Sur Seine (France), Sep. 1982 Previously announced as A82-42813 Transl. by Kanner (Leo) Associates, Redwood City, Calif.
(Contract NASW-3541)
(NASA-TM-77380; NAS 1.15:77380) Avail: NTIS HC A03/MF A01 CSCL 14B

A new method for computing the wall effects gives precise answers to some questions arising in adaptive wall concept applications: length of adapted regions, fairings with up and downstream regions, residual misadjustments effects, reference conditions. The acceleration of the iterative process convergence and the development of an efficient technology used in CERT T2 wind tunnels give in a single run the required test conditions. Samples taken from CAST 7 tests demonstrate the efficiency of the whole process to obtain significant results with considerations of tridimensional case extension. Author

N84-19361# Cranfield Inst. of Tech., Bedfordshire (England). Dept. of Aerodynamics.
AN EVALUATION OF A MOBILE AERODYNAMIC TEST FACILITY FOR HANG GLIDER WINGS
E. A. KILKENNY Nov. 1983 123 p
(COFA-8330; ISBN-0902-937-92-8) Avail: NTIS HC A06/MF A01

The size and flexible nature of hang glider wings makes it difficult to use conventional wind tunnel techniques to evaluate their aerodynamic characteristics. As an alternative, a mobile test facility was developed and an evaluation of this facility is detailed. Each component of the instrumentation is calibrated individually. This is followed by an overall evaluation using data obtained from tests on a rigid wing in a wind tunnel and on the mobile facility. The results confirm the feasibility of such a system and that resulting data is acceptable for investigations into hang glider aerodynamic and stability characteristics. Author

N84-19362*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SIMULATION APPLICATIONS AT NASA AMES RESEARCH CENTER
M. INOUYE Mar. 1984 21 p refs
(NASA-TM-85846; A-9503; NAS 1.15:85846) Avail: NTIS HC A02/MF A01 CSCL 14B

Aeronautical applications of simulation technology at Ames Research Center are described. The largest wind tunnel in the world is used to determine the flow field and aerodynamic characteristics of various aircraft, helicopter, and missile configurations. Large computers are used to obtain similar results through numerical solutions of the governing equations. Capabilities are illustrated by computer simulations of turbulence, aileron buzz, and an exhaust jet. Flight simulators are used to assess the handling qualities of advanced aircraft, particularly during takeoff and landing. Author

N84-19363# Air Force Human Resources Lab., Brooks AFB, Tex. Operations Training Div.
AIRCRAFT SIMULATOR: MULTIPLE-COCKPIT COMBAT MISSION TRAINER NETWORK Final Technical Paper
J. A. CICERO Jan. 1984 30 p
(Contract AF PROJ. 2743)
(AD-A137182; AFHRL-TP-83-46) Avail: NTIS HC A03/MF A01 CSCL 01C

The feasibility of a multiple-cockpit combat mission trainer (CMT) aircraft simulator is investigated. It is shown that a cable network can be used to connect many CMTs over a large geographical area. The cable channel is divided into a critical portion and noncritical portion. The critical portion uses a time division multiple access (TDMA) technique to broadcast CMT position and attitude to all other CMTs in the network. The noncritical data portion uses a random access protocol to broadcast weather, threat information, etc. An analysis technique is presented which easily evaluates the random access protocol. Suggestions for further research in this area are proposed. Author (GRA)

N84-19364# Naval Postgraduate School, Monterey, Calif.
DESIGN AND TESTING OF SCALED EJECTOR-DIFFUSERS FOR JET ENGINE TEST FACILITY APPLICATIONS M.S. Thesis
J. W. MOLLOY Sep. 1983 142 p
(AD-A136745) Avail: NTIS HC A07/MF A01 CSCL 14B

Design, fabrication and cold flow testing of a modeled jet engine test facility were conducted in an effort to provide an inexpensive vehicle to study geometric variations in diffuser geometry which could improve system efficiency. The design, which is based on Mach number similitude, consists of two configurations currently in use at the Naval Air Propulsion Center, Trenton, NJ. A constant area diffuser and a variable area diffuser with translating centerbody were modeled. Baseline mapping of the operating characteristics for each diffuser with representative scaled engines was conducted to provide a reference against which alternative geometries would be evaluated. The constant area plus two variants were tested. A five-sixths and two-thirds reduction were studied to investigate the potential for increasing efficiency for a specific engine diffuser combination at NAPC. Secondary flow provisions were incorporated into the design to allow variation of this parameter. The modeling results were consistent with theory and the test apparatus produced repeatable results. A two dimensional double ramp (wedge) capable of being translated in a rectangular duct was suggested as an alternative diffuser geometry. GRA

N84-19365# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
DYNAMIC CHARACTERISTICS OF A JET ENGINE TEST FACILITY AIR SUPPLY M.S. Thesis
M. L. ROSS Dec. 1983 154 p
(AD-A136910; AFIT/GAE/AA/83D-20) Avail: NTIS HC A08/MF A01 CSCL 20D

Dynamic response of a scale model of the Aeropropulsion Systems Test Facility (ASTF) air supply ducting was determined experimentally over a frequency range from 20-200 Hz. Blocked lines with no flow and orifice terminated lines with a mean flow were used. The experiments examined the effects of signal input on three different lines and of using different size venturis. Gain and phase were measured upstream of the venturi and at the end of the line. Experimental results were compared with the results of a computer program based on Nichols' theory as modified by Krishnaiyer and Lechner. With few exceptions, the gains were predicted within + or - 5 dB, and phase angles within + or - 10%. This agreement between theory and experiment verified that the theory can be applied successfully to large, complex systems and that the computer program was running properly. The verified program was then applied to the full-scale ASTF air supply and results analyzed. The ASTF results show higher gains at low frequencies and no reduction in the average gain with frequency. This was as expected for the large ASTF ducting, which ranges from 4-22 ft in diameter. GRA

N84-19366# Coordinating Research Council, Inc., Atlanta, Ga.
ELECTROSTATIC CHARGING TEST FOR AVIATION FUEL FILTERS
Nov. 1983 88 p
(AD-A136986; CRC-534) Avail: NTIS HC A05/MF A01 CSCL 13K

The objective of the field test program was the measurement of filter charging levels in actual aircraft fueling (hydrant cart) equipment to provide correlation data for the laboratory charging test program. The field test location and equipment were selected to provide a high total fuel throughput under typical refueling conditions. The designated hydrant carts were equipped with new separator elements supplied from specific batches by two major manufacturers. Periodic electrostatic charging measurements were conducted over a range of typical refueling conditions, which could be approximated in the laboratory program. New and used filter elements from the selected batches and representative fuel samples were provided to the laboratory program for correlative measurements. GRA

N84-19367# Naval Training Equipment Center, Orlando, Fla.
PREDICTOR DISPLAYS AS TRAINING AIDS IN CARRIER LANDINGS
D. R. WELLER Nov. 1983 20 p
(Contract NR PROJ. F57-526)
(AD-A136643; NAVTRAEQUIPC-TN-66) Avail: NTIS HC A02/MF A01 CSCL 05I

This report presents an evaluation of the effectiveness of predictor displays as training aids in carrier landing. An experiment was performed in which two predictor displays were compared with a control condition, where the principal measure was total approaches necessary to reach criterion performance. Also evaluated were three presentation modes for the predictor displays. The experiment was carried out on a low-cost device which simulated an A-7 aircraft. Analysis of the data indicated no significant differences between groups; although one predictor display consistently yielded better performance than the other conditions. Author (GRA)

10

ASTRONAUTICS

Includes astronautics (general); astrodynamics; ground support systems and facilities (space); launch vehicles and space vehicles; *space transportation; spacecraft communications, command and* tracking; spacecraft design, testing and performance; spacecraft instrumentation; and spacecraft propulsion and power.

N84-18224*# National Aeronautics and Space Administration, Washington, D. C.
REMEMBERED IMAGES, NASA 1958-1983
1983 138 p Original contains color illustrations
(NASA-EP-200; NAS 1.19:200) Avail: SOD HC $22.00 as 033-000-00901-1 CSCL 22A

A pictorial retrospective of NASA's first 25 years is presented. The Space Shuttle, manned space flight, space sciences, aeronautical research, and Earth orbit applications are discussed. N.W.

N84-18461# Rockwell International Corp., Downey, Calif. Shuttle Orbiter Div.
SPACE SHUTTLE ORBITER RUDDER/SPEED BRAKE ACTUATION SYSTEM
D. WOOLHOUSE *In* ESA First European Space Mech. and Tribology Symp. p 55-61 Dec. 1983
Avail: NTIS HC A10/MF A01

A mechanical-hydraulic actuation system for control of the rudder and speed brake aerosurfaces of the Space Shuttle orbiter is described. The rudder/speed brake functions are combined in a split-panel rudder design, mounted at the trailing edge of the large vertical stabilizer. Actuation of both panels in the same direction provides conventional rudder (yaw) control; actuation differentially, in a flared configuration, results in added aerodynamic drag for control of speed and pitch. Panel actuation is accomplished by a hydromechanical system responding to quadredundant avionic command inputs. The system consists of a power conversion and control component, the power drive unit, 4 geared rotary actuators, and 10 torque transmitting drive shafts. Author (ESA)

N84-19391# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
NONLINEAR MODELING AND INITIAL CONDITION ESTIMATION FOR IDENTIFYING THE AEROTHERMODYNAMIC ENVIRONMENT OF THE SPACE SHUTTLE ORBITER M.S. Thesis
C. D. LUTES Dec. 1983 119 p
(AD-A136928; AFIT/GAE/AA/83D-14) Avail: NTIS HC A06/MF A01 CSCL 20M

This report describes improvements made to the data analysis tool HEATEST, used for identification of the reentry aerothermodynamic environment of the Space Shuttle Orbiter. The heating model was changed from a linear perturbation form to that of a piecewise linear interpolation form to account for nonlinear heating rates. Also, a fixed-point initial condition smoother was incorporated to gain better estimates of unknown initial temperatures. Verification of these modifications was accomplished by applications to both simulated and actual flight test data. Simulations of nonlinear heating rates indicated higher than actual coating thickness predictions for the linear perturbation model previously used. Flight results using the improved heating model provided additional verification of a time skew due to nonisothermal wall effects on the OMS pod. Estimation of initial temperatures using the fixed-point initial condition smoother enabled the identification of an unmodeled Mach or Reynolds number effect on the lower surface during the Mach 12 Pushover Pullup maneuver of STS-4. GRA

N84-19444# Aeritalia S.p.A., Torino (Italy). Space Sector.
THERMAL CONTROL OF TETHERED SATELLITE IN A VERY LOW ALTITUDE AERODYNAMIC MISSION
G. BORRIELLO, C. CHIARELLI, G. PELLIS, and F. AL-ASTRABADI *In* ESA Environ. and Thermal Control Systems for Space Vehicles p 407-416 Dec. 1983 refs
Avail: NTIS HC A25/MF A01

Aerodynamic heating rates that a very low altitude satellite (100 km) can experience were calculated. A theoretical analysis, evaluating Knudsen number for flow regimes from free molecular to transition, is presented. Although it is not possible to predict with high confidence level the heating rates in transition flow regimes, the analysis data can be used to facilitate theoretical development. Metallic and ceramic thermal shields to protect the satellite primary structure were investigated. Conventional design methods are proposed to control internal unit temperature.
Author (ESA)

11

CHEMISTRY AND MATERIALS

Includes chemistry and materials (general); composite materials; inorganic and physical chemistry; metallic materials; nonmetallic materials; and propellants and fuels.

A84-23826
JAPAN TITANIUM SOCIETY, ANNIVERSARY INTERNATIONAL SYMPOSIUM, 30TH, KOBE, JAPAN, NOVEMBER 15-18, 1982, PROCEEDINGS
Symposium supported by the Ministry of International Trade and Industry. Tokyo, Japan Titanium Society, 1983, 225 p. In English and Japanese.

Among the topics discussed are the status of titanium industries in Japan, the United States, Britain, France, and West Germany, marine and industrial applications of titanium and its alloys, desalination plant experience with Ti heat exchanger tubing, the use of Ti alloys in commercial aircraft, and the fabrication of Ti alloy aircraft components. Also considered are the application of Ti alloys to a rocket motor case, the fabrication of large Ti disks by means of a 65,000-metric ton press, the role of titanium in the development history of aircraft gas turbines, recent Ti alloy developments, titanium gas turbine component machining practices, and drop forgings produced from Ti alloys using the world's largest screw press.
O.C.

A84-23828#
COMMERCIAL AIRCRAFT AND TITANIUM
T. T. SETO (Boeing Commercial Airplane Co., Renton, WA) IN: Japan Titanium Society, Anniversary International Symposium, 30th, Kobe, Japan, November 15-18, 1982, Proceedings . Tokyo, Japan Titanium Society, 1983, p. 107-121.

A discussion is conducted concerning the commercial aircraft manufacturing industries' consumption of titanium and its alloys. It is noted that the greatest problem encountered in the supplying of Ti to the aerospace industry has been inadequate Ti-processing industry capacity, which has led to shortages during periods of surging demand. This has been notably the case of Ti sponge production. The Ti industry has, on the other hand, been plagued by uncertainty of demand and by the wide market swings that are endemic to such cyclical industries as the aerospace. It is noted that these demand surges, caused by rapid changes in commercial aviation and defense requirements, will probably remain a problem.
O.C.

A84-23832#
THE ROLE OF TITANIUM ALLOYS IN THE HISTORY OF JET ENGINES
E. F. BRADLEY IN: Japan Titanium Society, Anniversary International Symposium, 30th, Kobe, Japan, November 15-18, 1982, Proceedings . Tokyo, Japan Titanium Society, 1983, p. 151-160.

A development history is given for the process of titanium alloy development and application to aircraft gas turbines, with attention to the experiences of a major engine manufacturer. The use of Ti alloys is noted to have been crucial in the development of the large bypass turbofan engines which are currently standard in commercial aviation, since alternative materials have not been able to offer the combination of low density, high strength, weldability and corrosion resistance of Ti alloys. The easily forged Ti-6Al-4V alloy, moreover, has been extensively applied to the disk and blade structures of both the fan and compressor sections of such engines. Currently, aircraft engines employ up to 27 percent Ti alloy by weight.
O.C.

A84-23833#
RECENT DEVELOPMENT IN TITANIUM ALLOYS
S. FUJISHIRO (USAF, Materials Laboratory, Wright-Patterson AFB, OH) IN: Japan Titanium Society, Anniversary International Symposium, 30th, Kobe, Japan, November 15-18, 1982, Proceedings . Tokyo, Japan Titanium Society, 1983, p. 161-170. In Japanese, with abstract in English.

The first of two major categories by which commercial Ti alloys may be classified is that of high temperature (above 350 C) applications, typified by the Ti-6Al-2Sn-4Zr-2Mo-0.1Si alloy that has been extensively used in gas turbine engine components subjected to as much as 450 C. The demand for creep-resistant, near-alpha alloys for high temperature applications has led to the development of such Ti alloys as IMI-829, which exhibits creep and fatigue resistance up to 600 C. The second category is that of high strength and toughness applications for the room temperature-350 C range. This category is dominated by the Ti6Al-4V alloy, and includes a new class of beta and near-beta alloys such as Ti-8Mo-8V-2Fe-3Al.
O.C.

A84-23835#
THE APPLICATION OF TITANIUM ALLOYS IN JET ENGINE COMPONENTS
A. TANIMURA and Y. MORIKAWA (Kawasaki Heavy Industries, Ltd., Kobe, Japan) IN: Japan Titanium Society, Anniversary International Symposium, 30th, Kobe, Japan, November 15-18, 1982, Proceedings . Tokyo, Japan Titanium Society, 1983, p. 181-189. In Japanese, with abstract in English. refs

A discussion is presented concerning the Ti alloy compositions and feedstock production and fabrication processes which are currently encountered in gas turbine engine applications. It is noted that the manufacturing process parameters of Ti alloys affect the quality and performance of the engine components produced than most other alloys, thereby requiring very precise process control. Although experimentation with hundreds of different Ti alloys has been reported, only seven alloys account for the bulk of the 15-35 percent of Ti alloys figuring in the total weight of state-of-the-art engines. The most frequently used alloy is Ti-6Al-4V, in the form of both sheets and forgings.
O.C.

A84-24057#
ANALYSIS OF THE EFFECT OF OXYGEN ADDITION ON MINIMUM IGNITION ENERGY
J.-S. CHIN Journal of Energy (ISSN 0146-0412), vol. 7, Nov.-Dec. 1983, p. 710-715. refs

Previously cited in issue 17, p. 2710, Accession no. A82-35037

A84-24685
METHODS FOR INVESTIGATING POLYMER/METAL BONDED LAYERS [UNTERSUCHUNGSMETHODEN ZU POLYMER-METALL-HAFTSCHICHTEN]
O.-D. HENNEMANN and J. RICKEL (Fraunhofer-Institut fuer angewandte Materialforschung, Bremen, West Germany) IN: Adhesion as the basis for bonded materials and composites . Oberursel, West Germany, Deutsche Gesellschaft fuer Metallkunde, 1983, p. 165-179. In German.

Polymer/metal bonds are characterized, using Al/adhesive systems commonly applied in aircraft structures as an example. Methods applied include TEM, SEM, transmitted-light microscopy (TLM), TLM with polarized light and lambda plate, dark-field microscopy and electron diffraction; numerous photomicrographs are provided. The characteristics of the adhesive, primer, and metal surface are examined, and it is found that the macroscopic roughness of the layers does not play a primary role in determining the bond quality. It is necessary to identify components or structures in polymer or metal on a scale of a few nm in order to evaluate the relative importance of close interactions (on the 200-500-pm scale) and longer-range interactions (e.g., in the polymer) in controlling bond strength and durability. T.K.

A84-24963
FATIGUE CRACK INITIATION IN ALUMINIUM ALLOYS UNDER PROGRAMMED BLOCK LOADING
M. GABRA and C. BATHIAS (Compiegne, Universitede Technologie, Compiegne, France) Fatigue of Engineering Materials and Structures (ISSN 0160-4112), vol. 7, no. 1, 1984, p. 13-27. Research supported by the Direction des Recherches, Etudes et Techniques. refs

Tests for fatigue crack initiation were carried out on two different aluminum alloys. Results and analysis of initiation under constant amplitude loading are presented; elastic and elastoplstic analyses are applied. Initiation under programmed block loading is investigated and damage accumulation is discussed. Tests were performed on two notch root radii:5 and 0.5 mm. The electric potential method was used to detect fatigue crack initiation. Three point bending tests on smooth specimens were carried out to follow the evolution of damage during the crack initiation phase. Author

A84-25019
ON THE DEVELOPMENT OF PLASMA-SPRAYED THERMAL BARRIER COATINGS
R. SIVAKUMAR and M. P. SRIVASTAVA (Defence Metallurgical Research Laboratory, Hyderabad, India) Oxidation of Metals (ISSN 0030-770X), vol. 20, Oct. 1983, p. 67-73. refs

Various zirconate coatings were prepared on bare Nimonic-75 an on CoCrAlY bond coat by plasma spraying. The cyclic oxidation and hot-corrosion resistance of these coatings have been evaluated. The wide difference in the properties of these coatings has been rationalized in terms of the thermal expansion mismatch between the coating and the substrate. On continued thermal cycling and in presence of molten salt, the life-limiting factor has been identified to be oxidation of the bond coat. The interconnected porosity in the ceramic coating is mainly responsible for such oxidation, and controlling this porosity would lead to life improvement. Author

A84-25193
EFFECT OF MOISTURE ON STATIC AND FATIGUE BEHAVIOR OF ARAMID COMPOSITES
M. E. ROYLANCE and W. W. HOUGHTON (U.S Army, Army Materials and Mechanics Research Center, Watertown, MA) American Helicopter Society, Journal (ISSN 0002-8711), vol. 28, Oct. 1983, p. 3-7. refs

The purpose of this study was to examine the effect of absorbed moisture on the quasi-static and fatigue strength of an aramid/epoxy composite. These materials are proposed for use in helicopter rotor blades. The fatigue testing has been performed at a frequency of 10 Hz and a stress ratio of $R = 0.1$. Absorbed moisture is shown to have a marked effect on the quasi-static properties, decreasing the flexure strength and increasing the tensile strength. This behavior is probably related to the development of high axial stresses in the laminate as it is cooled from the core temperature of 177 C, and subsequent changes in these residual stresses upon moisture absorption and swelling. The mechanism of fatigue failure in these composites differs from that of aramid yarns, and is probably fiber/matrix abrasion. Both the wet and dry composites lose approximately 6.5 percent of ultimate tensile strength/decade of fatigue loading. Author

A84-25589
EVALUATION OF THERMAL-OXIDATIVE STABILITY OF AVIATION OILS ON THE OP-100 DEVICE [OTSENKA TERMOOKISLITEL'NOI STABIL'NOSTI AVIATSIONNYKH MASEL NA PRIBORE OP-100]
E. N. CHVYKOVA, O. A. ZAPOROZHSKAIA, V. V. GORIACHEV, and E. P. FEDOROV Khimiia i Tekhnologiia Topliv i Masel (ISSN 0023-1169), no. 1, 1984, p. 29, 30. In Russian.

The use of the OP-100 to evaluate in laboratory conditions the thermal-oxidative stability of mineral and synthetic aviation oils and to reveal factors limiting the formation of high-temperature deposits is described. The OP-100 implements two oil oxidation processes: in a volume (by air bubbling through an oil layer at operating temperature) and in a film (by repeated transitory contact of a part of the oxidized oil with a metallic surface heated to high temperature). A comparison of test results for the present device and the TSM-1 (according to GOST 23797-79) is presented for several oils, including MK-8, 36/1Ku-A, B-3V, and LZ-240. The present evaluations of thermal-oxidative stability coincide with generally accepted standards. J.N.

A84-25590
THE FILTERABILITY OF T-6 FUEL AT LOW TEMPERATURES [FIL'TRUEMOST' TOPLIVA T-6 PRI PONIZHENNYKH TEMPERATURAKH]
A. I. BELOUSOV, E. M. BUSHUEVA, and D. G. RUDIAKOV (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Neftianoi Promyshlennosti, Moscow, USSR) Khimiia i Tekhnologiia Topliv i Masel (ISSN 0023-1169), no. 2, 1984, p. 25, 26. In Russian. refs

It has been shown in earlier studies that a deterioration of the filterability of oils at low temperatures is caused by structural transformations in petroleum products resulting in the formation of hydrocarbon molecular complexes. A similar study is reported here for T-6 jet fuel. In order to estimate the effect of structural transformations on the filtration time, control tests were carried out on a fuel imitator (vaseline oil). Test temperatures were selected on the basis of the viscosity vs temperature curves at points where the two fluids had the same viscosity. Test results show that, as in the case of oils, an increase in the filtration time of T-6 fuel at low temperatures results from the formation of hydrocarbon molecular complexes whose size is comparable with that of the filter pores. V.L.

A84-25591
FUELS FOR TESTING AIRCRAFT GAS TURBINE ENGINES [TOPLIVA DLIA ISPYTANII AVIATSIONNYKH GAZOTURBINNYKH DVIGATELEI]
A. F. GORENKOV, G. B. SKOVORODIN, and I. G. KLIUIKO Khimiia i Tekhnologiia Topliv i Masel (ISSN 0023-1169), no. 2, 1984, p. 29, 30. In Russian.

In order to increase the confidence level of test results for aircraft gas turbine engines, it is recommended that the engines be tested using reference fuels whose principal characteristics vary within a narrow range that is closer to the lower limits of the standard specification. A classification of the existing jet fuels is presented, and requirements are formulated for reference fuels based on T-2 and T-6, which are the highest-quality and lowest-quality fuels, respectively. V.L.

N84-18410# Monsanto Research Corp., Dayton, Ohio.
TURBINE ENGINE LUBRICANT RECLAMATION Final Report, 1 Sep. 1979 - 1 Mar. 1983
R. J. BRUNS and G. L. BEEMSTERBOER Wright-Patterson AFB, Ohio AFWAL Jun. 1983 265 p
(Contract F33615-79-C-2052; AF PROJ. 3048)
(AD-A135926; MRC-DA-1120; AFWAL-TR-83-2042) Avail: NTIS HC A12/MF A01 CSCL 11H

A distillation and adsorption treatment for reclaiming used MIL-L-7808 turbine oils was investigated. A viable additive package was tested on different MIL-L-7808 type virgin base stocks. Fifteen used oils were analyzed by acid number, high performance liquid chromatography, and gas chromatography. A distillation process utilizing caustic (sodium hydroxide) pretreatment was developed on 500-mL and 13-liter scales. Adsorption treatment of distilled oils consisted of barium hydroxide monohydrate. A total of ten 15-25 gallon batches of oil were reclaimed/reformulated and MIL-L-7808H tested. Test results were generally good. However, none of the 10 batches completely passed all of the tests. An extensive screening procedure was found necessary to identify contaminated used oil samples. An engineering cost study is included. GRA

N84-18413# Oak Ridge National Lab., Tenn.
STATUS, NEEDS, AND OPPORTUNITIES FOR STRUCTURAL CERAMICS IN ADVANCED HEAT ENGINES
V. J. TENNERY 1983 12 p refs Presented at the Mater. Res. Soc. Ann. Meeting, Boston, 14 Nov. 1983
(Contract W-7405-ENG-26)
(DE84-003307; CONF-831174-43) Avail: NTIS HC A02/MF A01

The potential for using structural ceramic materials in components of advanced heat engines including the gas turbine and adiabatic diesel has recently been demonstrated by results in DOE and DOD engine development programs. Status of these efforts, technical needs for candidate ceramic materials, and research opportunities in new DOE and NASA ceramic technology programs oriented to heat engines are reviewed. DOE

N84-18418*# Oak Ridge National Lab., Tenn. Chemistry Div.
ELECTRON SPIN RESONANCE STUDY OF THERMAL INSTABILITY REACTIONS IN JET FUELS Annual Report
H. ZELDES and R. LIVINGSTON Jan. 1984 51 p refs
(Contract W-7405-ENG-26)
(NASA-CR-168333; NAS 1.26:168333) Avail: NTIS HC A04/MF A01 CSCL 21D

Free radicals were studied by electron spin resonance (ESR) using model compounds that are representative of constituents of jet fuels. Radical formation was initiated with peroxides and hydroperoxides by using UV photolysis at and near room temperature and thermal initiation at higher temperatures. Both oxygen free and air saturated systems were studied. N-Dodecane was frequently used as a solvent, and a mixture of n-dodecyl radicals was made with a peroxide initiator in n-dodecane (free of oxygen) thermally at 212 C and photolytically at room temperature. Hydrogen abstraction from the 3,4,5 and 6-positions gives radicals that are sufficiently alike that their spectra are essentially superimposed. The radical formed by abstract of hydrogen from the 2-position gives a different spectrum. ESR parameters for these radicals were measured. The radical formed by abstraction of a primary hydrogen was not observed. Similar radicals are formed from n-decane. A variety of exploratory experiments were carried out with systems that give free radical spectra to which was added small amounts of 2,5-dimethylpyrrole. Author

N84-18419*# Midwest Research Inst., Kansas City, Mo. Center for Safety and Engineering Analysis.
EXPERIMENTAL RESULTS FOR THE RAPID DETERMINATION OF THE FREEZING POINT OF FUELS Final Report
B. MATHIPRAKASAM 9 Feb. 1984 62 p refs
(Contract AS3-22543)
(NASA-CR-168305; NAS 1.26:168305; MRI-7014-2) Avail: NTIS HC A04/MF A01 CSCL 21D

Two methods for the rapid determination of the freezing point of fuels were investigated: an optical method, which detected the change in light transmission from the disappearance of solid particles in the melted fuel; and a differential thermal analysis (DTA) method, which sensed the latent heat of fusion. A laboratory apparatus was fabricated to test the two methods. Cooling was done by thermoelectric modules using an ice-water bath as a heat sink. The DTA method was later modified to eliminate the reference fuel. The data from the sample were digitized and a point of inflection, which corresponds to the ASTM D-2386 freezing point (final melting point), was identified from the derivative. The apparatus was modified to cool the fuel to -60 C and controls were added for maintaining constant cooling rate, rewarming rate, and hold time at minimum temperature. A parametric series of tests were run for twelve fuels with freezing points from -10 C to -50 C, varying cooling rate, rewarming rate, and hold time. Based on the results, an optimum test procedure was established. The results showed good agreement with ASTM D-2386 freezing point and differential scanning calorimetry results. M.G.

N84-18420*# Case Western Reserve Univ., Cleveland, Ohio. Dept. of Electrical Engineering and Applied Physics.
APPLICATIONS OF PHOTOACOUSTIC TECHNIQUES TO THE STUDY OF JET FUEL RESIDUE Final Report, 22 Oct. 1980 - 20 May 1983
P. C. CLASPY 14 Nov. 1983 25 p refs
(Contract NAG3-98)
(NASA-CR-173322; NAS 1.26:173322) Avail: NTIS HC A02/MF A01 CSCL 21D

It has been known for many years that fuels for jet aircraft engines demonstrate thermal instability. One manifestation of this thermal instability is the formation of deleterious fuel-derived thermally-induced deposits on surfaces of the aircraft's fuel-handling system. The results of an investigation of the feasibility of applying photoacoustic techniques to the study of the physical properties of these thermal deposits are presented. Both phase imaging and magnitude imaging and spectroscopy were investigated. It is concluded that the use of photoacoustic techniques in the study of films of the type encountered in this investigation is not practical. S.L.

N84-18421# National Research Council of Canada, Ottawa (Ontario). Div. of Mechanical Engineering.
THE RELATIONSHIP BETWEEN ELECTRICAL CONDUCTIVITY AND TEMPERATURE OF AVIATION TURBINE FUELS CONTAINING STATIC DISSIPATOR ADDITIVES
L. GARDNER and F. G. MOON Oct. 1983 46 p
(AD-A135751; DME-DM-1; NRC-22648) Avail: NTIS HC A03/MF A01 CSCL 20D

The relationship between the electrical conductivity and temperature of Canadian produced wide-cut and kerosine type aviation turbine fuels containing static dissipator additives has been evaluated. Results obtained show that the temperature/conductivity coefficient, n, in the relationship log k subscript = n(t-t subscript 1) + log kt subscript 1 is dependent upon several factors including: (1) temperature range, (2) fuel type, and (3) additive type. It is recommended that the results of the evaluation be summarized and presented in the form of a test procedure which can be reference in aviation fuel specifications. Author (GRA)

N84-19475*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
FIRE-RETARDANT DECORATIVE INKS FOR AIRCRAFT INTERIORS
Z. NIR (Makhteshim, Ltd.), J. A. MIKROYANNIDIS (Patras Univ.), and D. A. KOURTIDES Feb. 1984 18 p refs
(NASA-TM-85876; A-9597; NAS 1.15:85876) Avail: NTIS HC A02/MF A01 CSCL 01C

Commercial and experimental fire retardants were screened for possible use wiith acrylic printing inks on aircraft interior sandwich panels. The fire retardants were selected according to their physical properties and thermostabilities. Thermostabilities were determined by thermogravimetric analysis and differential scanning calorimetry. A criterion was then established for selecting the more stable agent. Results show that some of the bromine-containing fire retardants are more thermostable than the acrylic ink, alone, used as a control. Also, the bromine-containing fire retardants yield even better limiting oxygen index values when tested after adding carboxy-terminated butadiene acrylonitrile (CTBN) rubber. Author

N84-19479*# Textron Bell Helicopter, Fort Worth, Tex.
FLIGHT SERVICE EVALUATION OF COMPOSITE COMPONENTS ON THE BELL HELICOPTER MODEL 206L, FLIGHT SERVICE REPORT Annual Report
H. ZINBERG Mar. 1984 37 p refs
(Contract NAS1-14279)
(NASA-CR-172296; NAS 1.26:172296; AR-1) Avail: NTIS HC A03/MF A01 CSCL 11D

The flight service components for the Bell Model 206L JetRanger helicopter are examined. The components were placed in service in the Continental United States, Canada, and Alaska. The status of 34 sets of components is discussed. Approximately 27,500 flight hours were accumulated on the components as of 1 August 1983. Three sets of components and one-fifth of the exposure coupons were returned and tested. The results are given. The overall behavior of the components and associated problems are discussed. Author

N84-19486# Massachusetts Inst. of Tech., Cambridge. Technology Lab. for Advanced Composites.
FRACTURE, LONGEVITY (FATIGUE), DYNAMICS, AND AEROELASTICITY OF COMPOSITE STRUCTURES Final Report, 1 Jan. - 31 Dec. 1982
P. A. LAGACE, J. W. MAR, and J. DUGUNDJI Jun. 1983 151 p
(Contract AF-AFOSR-0071-82; AF PROJ. 2307)
(AD-A137047; TELAC-83-11; AFOSR-84-0001TR) Avail: NTIS HC A08/MF A01 CSCL 11D

The results of several investigations into the fracture, longevity (fatigue), dynamics, and aeroelasticity of composite materials are reported. The experimental work was conducted using Hercules graphite/epoxy prepreg in two forms: AS1/3501-6 unidirectional tape and A370-5H/3501-6 fabric. The topics discussed include unnotched tensile fracture, sensitivity to notches under tensile loading, nonlinear stress-strain behavior, compression specimen development, damage growth under cyclic load, and the flutter and divergence of graphite/epoxy wings. Author (GRA)

N84-19536# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
EVALUATION OF FATIGUE-CREEP CRACK GROWTH IN AN ENGINE ALLOY M.S. Thesis
J. R. CHRISTOFF Dec. 1983 80 p
(AD-A136956; AD-E001638; AFIT/GA/AA/83D-2) Avail: NTIS HC A05/MF A01 CSCL 11F

This study investigates fatigue-creep interaction effects in alloys and evaluates the effectiveness of predictive models currently in use by the aircraft engine industry. The state-of-the-art crack growth rate prediction models are supplied by the General Electric Company (MSE) model, and the Pratt and Whitney Aircraft Group (SINH) model. They are used to predict crack growth rates under a range of conditions which involve fatigue-creep interactions. Another aspect of this study involves the development of an empirical model to predict fatigue-creep crack growth based on creep crack growth rate data and knowledge of the loading wave-form. This study is primarily directed toward high temperature (> or = 1000 F) fatigue-creep interaction at low test frequencies and positive stress ratios. The SINH model proves to be more accurate than the MSE model in predicting crack growth rates for the data analyzed. Both models predict linear relationships for the variations of crack growth rates for the MSE model in predicting crack growth rates for the data analyzed. Both models predict linear relationships for the variation of crack growth rates (da/dN) with the length of hold-time or the frequency rate on logarithmic coordinates. GRA

N84-19561# Technische Hogeschool, Delft (Netherlands). Dept. of Aerospace Engineering.
FATIGUE CRACK GROWTH IN ALUMINUM ALLOY SHEET MATERIAL UNDER CONSTANT AMPLITUDE AND SIMPLIFIED FLIGHT SIMULATION LOADING
H. MISAWA (Metropolitan Univ., Tokyo) and J. SCHIJVE Feb. 1983 41 p refs
(VTH-LR-381) Avail: NTIS HC A03/MF A01

Crack propagation tests were carried out on 2024-T3 aluminum alloy specimens. Flight simulation tests were carried out with constant gust cycles, and with a single overload at either the beginning or the end of each flight. Test variables were the number of gust cycles per flight and the stress level of the overload and the ground load. Crack growth interaction effects (retardations and accelerations) which might support crack growth prediction techniques were studied. Results include observations on the fracture surface transition from tensile mode to shear mode cracking. Crack growth rates strongly depend on stress ratio. Author (ESA)

N84-19565*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
REPEATABILITY OF MIXED-MODE ADHESIVE DEBONDING
R. A. EVERETT, JR. and W. S. JOHNSON Feb. 1984 27 p refs Presented at the ASTM Symp. on Delamination and Debonding of Mater., Pittsburgh, 8-10 Nov. 1983 Prepared in cooperation with Army Research and Technology Labs., Hampton, Va.
(Contract DA PROJ. 1L1-61102-AH-45)
(NASA-TM-85753; NAS 1.15:85753; USAAVSCOM-TR-84-B-1) Avail: NTIS HC A03/MF A01 CSCL 11A

The repeatability of debond growth rates in adhesively bonded subjected to constant-amplitude cyclic loading was studied. Debond growth rates were compared from two sets of cracked-lap-shear specimens that were fabricated by two different manufacturers and tested in different laboratories. The fabrication method and testing procedures were identical for both sets of specimens. The specimens consisted of aluminum adherends bonded with FM-73 adhesive. Critical values of strain-energy-release rate were also determined from specimens that were monotonically loaded to failure. The test results showed that the debond growth rates for the two sets of specimens were within a scatter band which is similar to that observed in fatigue crack growth in metals. Cyclic debonding occurred at strain-energy-release rates that were more than an order of magnitude less than the critical strain-energy-release rate in static tests. Author

N84-19580# Battelle Columbus Labs., Ohio. Macromolecular Science and Technology Sect.
IMPROVED PAINT REMOVAL TECHNIQUE Final Report
J. F. MANK, R. J. DICK, H. C. ABRAMS, and L. J. NOWACKI 25 Apr. 1978 151 p
(Contract F09603-77-A-0708)
(AD-A136671) Avail: NTIS HC A08/MF A01 CSCL 11C

The project was initiated with a brief visit to Robins Air Force Base to review their aircraft paint stripping operation. After that project initiation visit, Battelle contacted commercial airlines, aircraft manufacturers, military bases, contract stripping companies, and stripping chemical manufacturers to determine what the

state-of-the-art is in the field of stripping paint from aircraft. Many personal visits to stripping facilities were made to get first-hand information from the people involved with stripping aircraft and to see the actual stripping facility. A summary of the information obtained from these contacts is provided in the appendix of this report. The complete stripping of a C141 at Robins Air Force Base and the partial stripping of a KC-135 at Tinker Air Force Base were observed. The intent was to identify specific items and practices in the Warner Robins ALC operation that could be improved in order to decrease the amount of time required to strip an aircraft and therefore increase throughput. It was concluded that Warner Robins is essentially up with the state-of-the-art of airplane paint stripping that has been observed at other stripping facilities. GRA

N84-19590# Oak Ridge National Lab., Tenn.
CERAMIC COATINGS FOR HEAT ENGINE MATERIALS: STATUS AND FUTURE NEEDS
W. J. LACKEY, D. P. STINTON, G. A. CERNY, L. L. FEHRENBACHER, and A. C. SCHAFFHAUSER 1983 15 p refs Presented at Intern. Symp. on Ceramic Components for Engines, Hakone, Japan, 17 Oct. 1983
(Contract W-7405-ENG-26)
(DE84-003401; CONF-8310183-3) Avail: NTIS HC A02/MF A01

The current status and future potential for application of ceramic coatings to diesel and turbine engine components were assessed. Properties were tabulated for numerous materials from the oxide, carbide, nitride, and boride families. Promising new deposition methods and in-situ gas and solid phase characterization techniques are identified. Emphasis was placed on zirconia thermal barrier coatings, but coatings for reducing wear, erosion, and friction were also addressed. The use of coatings will expand in the future and permit higher performance and more reliable heat engines. DOE

N84-19596# Naval Research Lab., Washington, D. C. Combustion and Fuels Branch.
MICROBIAL DETERIORATION OF HYDROCARBON FUELS FROM OIL SHALE, COAL AND PETROLEUM. III: INHIBITION OF FUNGI BY FUELS FROM COAL Final Report
R. A. NEIHOF and M. E. MAY 16 Jan. 1984 27 p
(AD-A137177; NRL-MR-5253) Avail: NTIS HC A03/MF A01 CSCL 21D

The anticipated future need for hydrocarbon fuels from sources other than petroleum has impelled a thorough evaluation of the properties of such fuels, including their susceptibility to microbial contamination. The present work confirmed an earlier finding that a JP-5 fuel derived from coal by the Char Oil Energy Development (COED) process was inhibitory to typical fungal contaminants and showed that the inhibition extended to fuels produced by solvent refining as well as to a variety of COED fuels refined in different ways. The inhibition was not due to lack of a suitable aliphatic carbon source. Extraction of COED JP-5 fuel with aqueous solutions showed that the inhibitor(s) had a very low water solubility and was not markedly concentrated at the water/fuel interface. An experiment with silica gel as adsorbent indicated that solid adsorbents may furnish a means of removing and concentrating sufficient amounts of the inhibitor for identification. Additional work to identify the source of the fungal inhibition in coal fuel is worthwhile not only because of the pronounced and selective effects produced but because a novel inhibitor may be found which would be useful as a fuel-compatible biocide for controlling microbial contamination in any stored hydrocarbon fuel. Author (GRA)

N84-19597# Pratt and Whitney Aircraft Group, West Palm Beach, Fla. Government Products Div.
HEAT TRANSFER AND THERMAL STABILITY OF ALTERNATIVE AIRCRAFT FUELS, VOLUME 1 Final Report, 1 Jan. 1982 - 1 Feb. 1983
J. A. TEVELDE and M. R. GLICKSTEIN Nov. 1983 90 p 2 Vol.
(Contract N00140-80-C-0097; NR PROJ. Z08-38)
(AD-A137404; PWA/GPD-FR-17404-VOL-1; NAPC-PE-87-C-VOL-1) Avail: NTIS HC A05/MF A01 CSCL 21D

A test and evaluation program was conducted to determine the heat transfer and thermal stability characteristics of several selected alternative fuels. Accelerated fuel coking tests were conducted with three alternative fuels and a specification grade JP-5 fuel, in a heated tube apparatus. Test conditions included both simulated engine conditions and higher-temperature accelerated coking conditions. Resulting deposit rates were evaluated and correlated as a function of the test conditions. Deposit effects on heat transfer were also evaluated and correlated as a function of test condition. Author (GRA)

N84-19598# Pratt and Whitney Aircraft Group, West Palm Beach, Fla. Government Products Div.
HEAT TRANSFER AND THERMAL STABILITY OF ALTERNATIVE AIRCRAFT FUELS. VOLUME 2: APPENDICES Final Report, 1 Jan. 1982 - 1 Feb. 1983
J. A. TEVELDE and M. R. GLICKSTEIN Nov. 1983 96 p 2 Vol.
(Contract N00140-80-C-0097; NR PROJ. Z08-38)
(AD-A137405; PWA/GPD-FR-17404-VOL-2; NAPC-PE-87-C-VOL-2) Avail: NTIS HC A05/MF A01 CSCL 21D

The results from the alternative aircraft fuel tests are reported. The tests were conducted on three alternative fuels and a specific grade J-5 fuel. B.G.

N84-19599# Defence Research Establishment, Ottawa. (Ontario). Energy Systems Sect.
EFFECTS OF FUELS ON THE PHYSICAL PROPERTIES OF NITRILE RUBBER O-RINGS
J. R. COLEMAN and L. D. GALLOP Sep. 1983 26 p
(AD-A136647; DREO-TN-82-41) Avail: NTIS HC A03/MF A01 CSCL 11A

The effects were of sa variety of fuels and fuel blends on nitrile O-rings were studied. Properties (tensile strength, elongation, swelling) depended markedly on the aromatic content. When O-rings were cycled between fuels of low and high aromatic content, these properties took up values characteristic of the fuel in which the sample was currently immersed. Rubber samples were exposed to a commercial fuel (gas oil side stream) of high (greater than 40%) aromatics level and to a Jet A-1 fuel, initially meeting aromatics specifications, whose aromatics content had been artificially increased by addition of reagent chemicals to the same final level as the gas oil side stream. Effects on physical properties (tensile strength, swell, 200% modulus) were considerably greater for the Jet A-1 with added aromatics than for the gas oil side stream. GRA

N84-19600# Defence Research Establishment, Ottawa. (Ontario). Energy Systems Sect.
PROPERTIES OF FUELS EMPLOYED IN A GAS TURBINE COMBUSTOR PROGRAM
J. R. COLEMAN and L. D. GALLOP Sep. 1983 20 p
(AD-A136663; DREO-TN-82-42) Avail: NTIS HC A02/MF A01 CSCL 21D

A compilation has been made of the physical and chemical properties of sixteen fuels employed in an aircraft gas turbine combustor programme. Several of these are specification fuels of the kerosene or wide-cut type. Others have been chosen to exhibit systematic variations mainly in the direction of out-of-specification boiling range or aromatics level or both. Some are of non-petroleum origin, derived from oil shale or tar sands, or are synthetic fuels

(JP10, RJ6). Complete specification testing was conducted on these fuels, and detailed non-specification property determination-simulated distillation by gas chromatography, thermal stability breakpoint, density, specific heat, viscosity, surface tension and true vapor pressure, all as a function of temperature; heats of combustion, hydrogen content, and detailed hydrocarbon compositional analysis. Author (GRA)

12

ENGINEERING

Includes engineering (general); communications; electronics and electrical engineering; fluid mechanics and heat transfer; instrumentation and photography; lasers and masers; mechanical engineering; quality assurance and reliability; and structural mechanics.

A84-23229
FLYING HOT-WIRE ANEMOMETRY
B. E. THOMPSON and J. H. WHITELAW (Imperial College of Science and Technology, London, England) Experiments in Fluids (ISSN 0723-4864), vol. 2, no. 1, 1984, p. 47-55. Research supported by the Ministry of Defence and Department of Industry of England. refs

A flying hot-wire arrangement has been developed for the measurement of the velocity characteristics of the flow around airfoils, and particularly in regions where negative values of instantaneous velocity occur. The mechanism and signal processing system are described and appraised by comparing stationary and flying wire measurements obtained in the trailing edge region of a flap at an angle of attack which leads to upper-surface separation. Author

A84-23256
DISTRIBUTED ARRAY RADAR
R. C. HEIMILLER (Michigan, Environmental Research Institute, Ann Arbor, MI), J. E. BELYEA, and P. G. TOMLINSON (Decision-Science Applications, Inc., Arlington, VA) IEEE Transactions on Aerospace and Electronic Systems (ISSN 0018-9251), vol. AES-19, Nov. 1983, p. 831-839.
(Contract DAAK40-77-C-0112)

Distributed array radar (DAR) is a concept for efficiently accomplishing surveillance and tracking using coherently internetted mini-radars. They form a long baseline, very thinned array and are capable of very accurate location of targets. This paper describes the DAR concept. Factors involving two-way effective gain patterns for deterministic and random DAR arrays are analyzed and discussed. An analysis of factors affecting signal-to-noise ratio is presented and key technical and performance issues are briefly summarized. Author

A84-23319
FORMATION OF COHERENT STRUCTURES IN A TURBULENT WAKE UNDER ACOUSTIC EXCITATION [OBRAZOVANIE KOGERENTNYKH STRUKTUR V TURBULENTNOM SLEDE PRI AKUSTICHESKOM VOZDEISTVII]
N. N. IANENKO, S. P. BARDAKHANOV, and V. V. KOZLOV (Akademiia Nauk SSSR, Institut Teoreticheskoi i Prikladnoi Mekhaniki, Novosibirsk, USSR) Akademiia Nauk SSSR, Doklady (ISSN 0002-3264), vol. 274, no. 1, 1984, p. 50-53. In Russian.

Experiments were performed in a subsonic wind tunnel to study the transformation of acoustic perturbations to vortex perturbations (i.e., coherent structures) in the turbulent wake of a thin plate with a sharp trailing edge. The growth of the perturbation phase in the wake and the distribution of perturbation amplitude and phase over the transverse coordinate were investigated for a frequency of 518 Hz. The results show that acoustic oscillations are intensely transformed into vortex perturbations in the turbulent wake of a thin plate in a fashion analogous to that in laminar shear flows. B.J.

A84-23358#
THREE-DIMENSIONAL GRID GENERATION USING ELLIPTIC EQUATIONS WITH DIRECT GRID DISTRIBUTION CONTROL
C. F. SHIEH (General Motors Corp., Detroit Diesel Allison Div., Indianapolis, IN) AIAA Journal (ISSN 0001-1452), vol. 22, March 1984, p. 361-364. refs

Previously cited in issue 05, p. 636, Accession no. A83-16720

A84-23368#
FREQUENCY DETERMINATION TECHNIQUES FOR CANTILEVERED PLATES WITH BENDING-TORSION COUPLING
E. F. CRAWLEY (MIT, Cambridge, MA) and D. W. JENSEN (Structures, Structural Dynamics and Materials Conference, 24th, Lake Tahoe, NV, May 2-4, 1983, Collection of Technical Papers. Part 2, p. 737-743) AIAA Journal (ISSN 0001-1452), vol. 22, March 1984, p. 415-420. refs
(Contract F3361-77-C-5155)

Previously cited in issue 12, p. 1745, Accession no. A83-29885

A84-23374#
ADHESIVE BONDED ORTHOTROPIC STRUCTURES WITH A PART-THROUGH CRACK
C. S. HONG (Korea Advanced Institute of Science and Technology, Seoul, Republic of Korea) and H. S. RO AIAA Journal (ISSN 0001-1452), vol. 22, March 1984, p. 443-445. refs

The isotropic structure solution of Ratwani (1979) is extended to adhesive bonded structures with a part-through crack. Stress intensity factors for no debond and elliptical debond, and the shear stress distribution on the adhesive layer were calculated. The present method is useful for analyzing crack problems in both two-orthotropic-ply and two-isotropic-ply adhesively bonded structures. J.N.

A84-23829#
FABRICATION OF TITANIUM AND ITS ALLOYS FOR AIRCRAFT COMPONENTS
M. OHSUMI and T. TSUZUKU (Mitsubishi Heavy Industries, Ltd., Nagoya Aircraft Works, Nagoya, Japan) IN: Japan Titanium Society, Anniversary International Symposium, 30th, Kobe, Japan, November 15-18, 1982, Proceedings . Tokyo, Japan Titanium Society, 1983, p. 123-132. In Japanese, with abstract in English. refs

The main fabrication methods for aircraft structures have been room temperature sheet metal forming and machining and assembly by rivetting; both are successful because of the good machinability and room temperature formability of aluminum alloys. The fabrication methods for titanium alloys are somewhat different. Integrated structure and near-net shape materials are apt to be applied in aircraft fabrication. For integration of sheet metal structure, the fabrication methods using superplastic forming as the main process are considered to be most effective. Superplastic forming while increasing temperature is superior to that at a constant temperature. Moreover, the rather long time required for fabrication of large integrated parts can be reduced by this process. It is very attractive for solid blocks, for such near-net shape processes as HIP, for isothermal forging, for precision forging, etc. Welding such as diffusion bonding or electron beam welding, is effective for building up larger, forging-type parts from plate stock and smaller forgings, and for bringing about unique shapes, such as hollow parts. Author

A84-23831#

LARGE TITANIUM DISC MANUFACTURED UNDER THE 65,000 METRIC TON PRESS

J.-B. RAMBAUD (Creusot-Loire, Pamiers, Ariege, France) IN: Japan Titanium Society, Anniversary International Symposium, 30th, Kobe, Japan, November 15-18, 1982, Proceedings . Tokyo, Japan Titanium Society, 1983, p. 139-145.

A large, closed dye process for titanium fabrication is presently illustrated by the case of a 385-kg Ti-6Al-4V hub front compressor. The process employs a 65,000 metric ton press, and the front hub compressor produced may be the largest aircraft engine rotating component ever to have been forged in Ti alloy. The advantages of the use of such a large press include the production of large disks with the minimum number of heatings, and avoiding the strength - compromising use of joints which is entailed by the building up of structures of this scale from smaller ones. O.C.

A84-23834#

MACHINING OF COMPONENT PARTS OF AIRCRAFT JET ENGINE

Y. NISHI (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan) IN: Japan Titanium Society, Anniversary International Symposium, 30th, Kobe, Japan, November 15-18, 1982, Proceedings . Tokyo, Japan Titanium Society, 1983, p. 171-179. In Japanese, with abstract in English. refs

Many factors are important in a good aircraft jet engine, such as small size, light weight, low fuel consumption, large output, and high operational reliability. Therefore, the jet engine uses various kinds of Ti-alloys with high specific strength (tensile strength/density), and Ni- and/or Co-alloys with high temperature strength, for many kinds of component parts. Generally, these are known as the difficult-machining materials because of the short tool life associated with their fabrication. Moreover, these have the remarkable tendency to decrease their fatigue strength according to the changes of the surface layer by the machining processes and conditions. Because the walls of jet engine parts are rather thin compared to their size, and the shapes are complicated, various kinds of manufacturing techniques are used to produce them. This paper introduces some of the changes of the surface layer of Ti-alloys made by various machining processes, and also contains some American data concerning fatigue strength after machining. The production engineer must take into full account the 'producibility' as well as 'productivity', which will lead to 'reliability'. Author

A84-23871

WEAK SPHERICAL SHOCK-WAVE TRANSITIONS OF N-WAVES IN AIR WITH VIBRATIONAL EXCITATION

H. HONMA (Chiba University, Chiba, Japan) and I. I. GLASS (Toronto, University, Downsview, Ontario, Canada) Royal Society (London), Proceedings, Series A - Mathematical and Physical Sciences (ISSN 0080-4630), vol. 391, no. 1800, Jan. 9, 1984, p. 55-83. Research supported by the Natural Sciences and Engineering Research Council of Canada, Japan Society for the Promotion of Science, and U.S. Army. refs

(Contract AF-AFOSR-82-0097)

The effects of vibrational excitation on the shock-wave transitions of weak, spherical N-waves which are generated by using sparks and exploding wires as sources are studied by solving numerically the compressible Navier-Stokes equations, with a vibrational-relaxation equation for oxygen. An explosion from a small pressurized sphere filled with air is used to simulate the N-waves from the actual sources. The effects of artificial viscosity appearing in finite-difference schemes are eliminated and accurate profiles of the shock transitions are obtained by using the random-choice method with an operator-splitting technique. It is shown that a computer simulation can be made by using a proper choice of initial parameters to obtain the variations of N-wave overpressure and half-duration with distance from the source. It is also shown that the calculated rise times simulate both spark and exploding-wire data. In addition to the vibrational-relaxation time of oxygen, both the duration (N-wave effect) and the attenuation rate (nonstationary effect) of a spherical N-wave are found to be important factors controlling its rise time. C.R.

A84-23901

COMPOSITE PART PRODUCTION TECHNIQUES REVIEWED

D. J. HOLT Aerospace Engineering (ISSN 0736-2536), vol. 3, Sept. 1983, p. 9-13.

Some of the techniques used by production and manufacturing engineers in the fabrication of graphite-epoxy composite aircraft parts are reviewed. Although the tooling used for the production of early graphite composite parts was the same as that used for fiberglass skin parts, changes were necessary for successful results at the higher curing temperatures and higher pressures. The three types of tooling currently used for the manufacture of composite aircraft parts are a high-temperature resin system, electroplated nickel, or graphite composite tooling. Construction with the use of high-temperature composite materials, polyamides, is considered, as well as the use of conveyor lines and robots. J.N.

A84-23906#

NONDESTRUCTIVE EXPERIMENTAL METHOD FOR DETERMINING CRITICAL LOADS OF SHELL STRUCTURES UNDER EXTERNAL PRESSURE

H. CHEN, W. LI, H. RONG, and M. SONG (Aircraft Structural Mechanics Research Institute, People's Republic of China) Acta Aeronautica et Astronautica Sinica, vol. 4, Sept. 1983, p. 28-35. In Chinese, with abstract in English. refs

A nondestructive experimental method is provided for determining critical loads of shell structures under external pressure. It is a step-by-step method, using normal deflection of shell structures as a control variation. Nondestructive.buckling tests were completed with the presented method on nine cylindrical panels made of LY12-CZ aluminum alloy with circumferential omega-stiffeners and on internal panels of 3rd to 6th oil boxes in an airplane fuselage. The critical pressures of shells were exactly determined. A preliminary investigation on the influence of circumferential restraint on the buckling loads of stiffened cylindrical panels has been carried out. The test results show that the nondestructive buckling experimental method is a success. Author

A84-23922

VOICES IN THE AIR - THE EARLY DAYS OF AIRCRAFT NDT

R. STRAW Materials Evaluation (ISSN 0025-5327), vol. 42, Feb. 1984, p. 152-160. refs

It is noted that by the mid-1950s, nearly every major NDT method had been applied to the inspection of aircraft. A table is included that offers a sampling of aircraft industry uses of NDT from the late 1940s to the mid-1950s. The impetus provided by the demands from the Korean War is noted. Many inventions and combinations of existing NDT equipment were seen in the decade after World War II. Quite a few of these had to do with ultrasonics, which at that time was a relatively new NDT method. A description is given of the early form of computerized automation of NDT using punch cards for record filing of radiographs. The development of industry-wide associations for aircraft NDT is traced. C.R.

A84-23925

THE IMPLEMENTATION OF A COMPUTERIZED ULTRASONIC SCAN SYSTEM

V. E. PANHUISE, L. RICHMOND, and R. NOVAK (Garrett Turbine Engine Co., Phoenix, AZ) Materials Evaluation (ISSN 0025-5327), vol. 42, Feb. 1984, p. 231-238.

The system has the ability to inspect near-net shape forgings, thereby reducing the costs associated with the inspection. It has sufficient sensitivity to detect a 0.016 in. diameter defect 0.050 in. from the surface in the powder metal Astroloy. The automated setup controls ensure that disks from the same part number will be inspected identically and that the data will be interpreted objectively on the basis of a controlled criterion. The design of the system makes use of a central computer to control the basic components of an ultrasonic immersion-scanning inspection system. Whereas a conventional ultrasonic testing system uses

an immersion scan tank, a transducer, and an ultrasonic pulser/receiver, the system described uses these same components, but in a different way. Rather than the inspector controlling the programming of the hardware, the microcomputer handles the controlling functions. C.R.

A84-24208#

ROUGHNESS INDUCED TRANSITION AND HEAT TRANSFER AUGMENTATION IN HYPERSONIC ENVIRONMENTS

A. T. WASSEL (Science Applications, Inc., Hermosa Beach, CA), W. C. L. SHIH (Physical Research, Inc., Palos Verdes, CA), and J. F. COURTNEY (TRW Defense Systems Group, Redondo Beach, CA) IN: Aerodynamic Testing Conference, 13th, San Diego, CA, March 5-7, 1984, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1984, p. 313-328. refs
(Contract F04701-77-C-0126)
(AIAA PAPER 84-0631)

Boundary layer transition and surface heating distributions on graphite, fine weave carbon-carbon, and metallic nosetip materials were derived from surface temperature responses measured in nitrogen environments during both free-flight and track-guided testing in hypersonic environments. Innovative test procedures were developed, and heat transfer results were validated against established theory through experiments using a super-smooth tungsten model. Quantitative definitions of mean transition front locations were established by deriving heat flux distributions from measured temperatures, and comparisons made with existing nosetip transition correlations. Qualitative transition locations were inferred directly from temperature distributions to investigate preferred orientations on fine weave nosetips. Levels of roughness augmented heat transfer were generally shown to be below values predicted by state-of-the-art methods. Author

A84-24427

PROCEDURE FOR WORKING UP A CASE OF STRUCTURAL DAMAGE [VORGEHENSWEISE BEI DER BEARBEITUNG EINES SCHADENSFALLES]

G. LANGE (Braunschweig, Technische Universitaet, Brunswick, West Germany) IN: Systematic evaluation of technical damage-cases . Oberursel, West Germany, Deutsche Gesellschaft fuer Metallkunde, 1983, p. 7-14. In German. refs

Basic ground rules and decision criteria for working up a case of structural damage are discussed. Methods to preserve evidence and obtain information on the cause of the damage are summarized. Procedures for working up microscopic and macroscopic damage, conducting simulation tests and materials tests, and writing damage reports with recommendations for improvements are briefly considered. C.D.

A84-24561

DYNAMIC ANALYSIS OF PRACTICAL BLADES WITH SHEAR CENTER EFFECT

V. KARADAG (Istanbul, Technical University, Istanbul, Turkey) Journal of Sound and Vibration (ISSN 0022-460X), vol. 92, Feb. 22, 1984, p. 471-490. refs

Shear center effects on the natural frequencies and mode shapes of rotating and non-rotating practical blades are considered. An 18 degrees of freedom thick beam finite element is developed. Bending and shear force displacements and slopes, and torsional displacements are taken as degrees of freedom at both ends of the element. Total blade deflection slopes are considered as composed of bending and shear force deflection slopes in calculations of blade strain and kinetic energy. This element is compared with the existing thin and thick beam finite elements, and theoretical models. Results obtained for the vibration characteristics of rotating and non-rotating non-uniform aerofoil cross-sectioned blades are compared with the available calculated and experimental values. In all cases considered the element exhibits good convergence characteristics and produces accurate results. Author

A84-24683

ADHESION BETWEEN METALS AND NONMETALS - LONG APPLIED, BUT STILL NOT UNDERSTOOD [ADHAESION ZWISCHEN METALLEN UND NICHTMETALLEN - SEIT LANGEM GENUTZT, NOCH IMMER NICHT VERSTANDEN?]

W. BROCKMANN (Fraunhofer-Institut fuer angewandte Materialforschung, Bremen, West Germany) IN: Adhesion as the basis for bonded materials and composites . Oberursel, West Germany, Deutsche Gesellschaft fuer Metallkunde, 1983, p. 105-122. In German. refs

The historical development of metal/nonmetal bonding processes is traced, and the state of present knowledge is illustrated for Al/polymer bonds used in aircraft structures. While a wide variety of processes have been employed since the Bronze Age, theoretical understanding remained limited and purely empirical optimization techniques were employed, often with surprising success. The adhesion requirements, environmental exposure, and typical failure mechanisms of polymer-glued Al aircraft structures are discussed, and photographs of debonded surfaces are shown. A wet-peeling test for the experimental investigation of the weakening of these bonds is described, and sample results are presented in photographs and a graph. In preliminary studies, TEM examination of bonded layers reveals the presence of a 20-30-nm-thick layer of primer near the Al2O3 surface which has an appearance different from that of the remaining primer and may be subject to water weakening. T.K.

A84-24714

STRENGTH, QUALITY, AND LIFETIME IN THE CASE OF HOT ENGINE COMPONENTS [FESTIGKEIT, QUALITAET UND LEBENSDAUER BEI TRIEBWERKSHEISSTEILEN]

P. ESSLINGER (Motoren- und Turbinen-Union Muenchen GmbH, Munich, West Germany) IN: Strength and deformation at high temperatures . Oberursel, West Germany, Deutsche Gesellschaft fuer Metallkunde, 1983, p. 309-323. In German.

In gas turbines for aircraft, the engine components are subjected to high operational temperatures, hot combustion gases, and, in the case of rotating parts, high-level centrifugal forces. The present investigation is concerned with typical mechanical-thermal alternating stresses related to the creep range of the materials, taking into account turbine blades, turbine disks, and compressor disks of the last stages. Attention is given to loading cycles in the engine for blades and disks, creep strength and creep life for various blade materials, an increase in operational temperature for gas turbine blades achieved by an employment of unidirectionally solidified materials, the effect of protective layers on the behavior of turbine blades subjected to load reversal, the speed of crack propagation in turbine disk materials, and the effect of crack-like defects. G.R.

A84-24726* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

DESIGN AND IMPLEMENTATION OF A MULTIGRID CODE FOR THE EULER EQUATIONS

D. C. JESPERSEN (NASA, Ames Research Center, Moffett Field, CA) Applied Mathematics and Computation (ISSN 0096-3003), vol. 13, 1983, p. 357-374. refs

The steady-state equations of inviscid fluid flow, the Euler equations, are a nonlinear nonelliptic system of equations admitting solutions with discontinuities (for example, shocks). The efficient numerical solution of these equations poses a strenuous challenge to multigrid methods. A multigrid code has been developed for the numerical solution of the Euler equations. In this paper some of the factors that had to be taken into account in the design and development of the code are reviewed. These factors include the importance of choosing an appropriate difference scheme, the usefulness of local mode analysis as a design tool, and the crucial question of how to treat the nonlinearity. Sample calculations of transonic flow about airfoils will be presented. No claim is made that the particular algorithm presented is optimal. Author

A84-24744

CONDITION OF A PRIORI MONOTONICITY OF HEAT FLUX AT A BOUNDARY [USLOVIE APRIORNOI MONOTONNOSTI TEPLOVOGO POTOKA NA GRANITSE]

N. V. MUZYLEV Zhurnal Vychislitel'noi Matematiki i Matematicheskoi Fiziki (ISSN 0044-4669), vol. 24, Feb. 1984, p. 287-293. In Russian. refs

The present study examines a mixed boundary value problem for a quasi-linear parabolic equation which is one-dimensional with respect to the spatial variables. Temperature is given at one boundary point, and the heat flux goes to zero at another boundary point. A condition for temperature at the first boundary point is given, the fulfillment of which provides for the monotonicity of the heat flux at that point as a function of time. The necessary condition for the monotonicity of the heat flux is also presented. B.J.

A84-24831

EVALUATION OF LOSSES AS A FUNCTION OF ANGLE OF ATTACK IN CASCADES OF AXIAL TURBINE STAGES [K OTSENKE POTER' V RABOCHIKH RESHETKAKH OSEVYKKH TURBINNYKH STUPENEI V ZAVISIMOSTI OT UGLOV ATAKI]

K. L. LAPSHIN and V. A. CHERNIKOV (Leningradskii Politekhnicheskii Institut, Leningrad, USSR) Energetika (ISSN 0579-2983), Jan. 1984, p. 62-68. In Russian. refs

It is shown that the net characteristics may be used to obtain the averaged profile losses in a turbine stage cascade for various angles of attack. The coefficients of loss for turbine blades in a cascade were experimentally determined for seven model turbine stages with various characteristics associated with gas turbines, steam turbines, and turbines with tangentially inclined guide vanes. Curves of the experimental loss coefficients as a function of angle of attack show that the minimum losses occur at small positive angles of attack. This is apparently connected to the end effects in the guide vane cascade, particularly in the root sections. J.N.

A84-24976

A NUMERICAL ANALYSIS OF THE FLOW ARROUND STRUCTURES BY THE DISCRETE VORTEX METHOD

H. SAKATA, T. SAITO, T. ADACHI, and T. INAMURO (Mitsubishi Heavy Industries, Ltd., Nagasaki Technical Institute, Nagasaki, Japan) Mitsubishi Heavy Industries Technical Review (ISSN 0026-6817), vol. 20, Oct. 1983, p. 206-211. refs

A new discrete vortex method is described, which was developed for the analysis of an unsteady separated flow around a structure. In this method, the flow around the structure is assumed to be a potential flow except in the region of free shear layers, which are shed downstream from the separation points, and the free shear layers and the structure are represented by discrete vortices. Accordingly, this method can be easily applied to a complicated shape such as a structure, because the conformal mapping used in the usual discrete vortex methods is not required in this method. The analysis is applied to the flow calculations around a square prism with angle of attack, girder bridge and two square prisms perpendicular to the flow. The calculated results are compared with the experimental data, and good agreement has been obtained. Author

A84-25230* Complere, Inc., Palo Alto, Calif.

APPLICATION OF LASER VELOCIMETRY TO UNSTEADY FLOWS IN LARGE SCALE, HIGH SPEED TUNNELS

F. K. OWEN (Complere, Inc., Palo Alto, CA) IN: ICIASF '83; International Congress on Instrumentation in Aerospace Simulation Facilities, Saint-Louis, Haut-Rhin, France, September 20, 1983, Record . New York, Institute of Electrical and Electronics Engineers, 1983, p. 237-250. refs

(Contract NAS2-11080)

The optical, seeding, and data reduction procedures which have been used in the successful application of laser velocimetry to large-scale, unsteady, transonic wind-tunnel testing are described. Flowfield measurements obtained at several facilities are presented. These results include vortex flow measurements and ensemble-averaged data obtained under conditions of vortex-shedding, dynamic stall airfoil oscillation, oscillating trailing-edge control flaps, and helicopter rotor flow fields. C.D.

A84-25559

CORRECTING THE IMPRESSION OF A DIE FOR MOLDING BLADE BLANKS FOR GAS TURBINE ENGINES [KORREKTSIIA GRAVIURY SHTAMPA DLIA FORMOOBRAZOVANIIA ZAGOTOVOK LOPATOK GTD]

V. IU. ZYKOV, A. F. PAVLOV, L. T. KAZAKOVA, and F. S. IUNUSOV Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 3, 1983, p. 27-32. In Russian.

In precision die forging of gas turbine blades it is essential that the configuration of the die be corrected to allow for the deformations resulting from residual stresses. A correction procedure is proposed here which involves developing a mathematical model describing the surface of the blade, calculating the coordinates of the forged blank profile, calculating the coefficients of the polynomials describing the blank profile, and correcting the impression of the die. The correction algorithm has been implemented in software written in FORTRAN IV. V.L.

A84-25561

CALCULATION OF HEAT TRANSFER COEFFICIENTS FOR TURBINE PROFILES WITH ALLOWANCE FOR SURFACE CURVATURE AND HIGH FLOW TURBULENCE [RASCHET KOEFFITSIENTOV TEPLOOTDACHI NA TURBINNYKH PROFILIAKH S UCHETOM KRIVIZNY POVERKHNOSTI I POVYSHENNOI STEPENI TURBULENTNOSTI POTOKA]

V. D. SOVERSHENNYI and S. P. CHIKOVA Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 3, 1983, p. 38-42. In Russian. refs

Local coefficients of heat transfer to a turbine profile are determined with allowance for surface curvature and high flow turbulence by integrating numerically partial differential equations for the boundary layer. It is assumed that the boundary layer contains zones of laminar, transition, and turbulent flows. A closed system of equations is obtained by using full transport coefficients. The heat transfer coefficients calculated for turbulences of 0.45 and 5.9 percent are found to be in good agreement with experimental data. V.L.

A84-25583

TURBULENT JET FLOW IN A DUCT WITH A CIRCULATION ZONE [TURBULENTNOE STRUINOE TECHENIE V KANALE S TSIRKULIATSIONNOI ZONOI]

G. A. GLEBOV and V. N. PETROV . Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 3, 1983, p. 104, 105. In Russian.

An approximation method is proposed for calculating flows resulting from the interaction between a turbulent jet and a slipstream inside a duct, including the case where a back stream is formed near the wall. In accordance with the approach proposed here, the velocity profile in the mixing region is determined using the well known method of the polynomial approximation of the Reynolds shear stress profile in the duct cross-sections. The flow parameters are then determined using integral equations of flow rate and momentum. The results obtained using the approximation method are found to be in good agreement with experiment data. V.L.

A84-25584

SOLUTIONS TO NONLINEAR PROBLEMS IN THE STRUCTURAL MECHANICS OF AIRCRAFT [O RESHENII NELINEINYKH ZADACH STROITEL'NOI MEKHANIKI LETATEL'NYKH APPARATOV]

S. K. CHERNIKOV Aviatsionnaia Tekhnika (ISSN 0579-2975), no. 3, 1983, p. 105-107. In Russian. refs

In nonlinear problems concerning the stress-strain state of structures, an operator control equation is usually reduced to a system of nonlinear algebraic equations using finite-diference, finite-sum, or some other well known techniques. The problem is then reduced to that of finding the roots of the nonlinear system. An approach to the solution of the nonlinear system of equations is proposed here which is based on the parameter continuation

algorithm. Two versions of the approach are examined and shown to be superior to other methods. V.L.

A84-25623

THE OSCILLATIONS OF A FLEXIBLE AIRCRAFT WHEN ACTED UPON BY A GUST OF WIND [KOLEBANIIA UPRUGOGO SAMOLETA POD DEISTVIEM PORYVA VETRA]

A. V. IVANOVA Leningradskii Universitet, Vestnik, Matematika, Mekhanika, Astronomiia (ISSN 0024-0850), Jan. 1984, p. 112-114. In Russian.

Consideration is given to the problem of determining the reaction of a swept wing aircraft of large extension to a single gust of wind having an arbitrary velocity distribution in the direction of flight and a uniform distribution in the span direction. The aircraft's velocity does not change in passing through the gust. The aircraft wing is treated as a thin-walled elastic rod and the fuselage as a rigid body capable of vertical displacement (as a function of time) and rotation in the plane of symmetry of the aircraft around the center of gravity to an angle that is also a function of time. The symmetrical oscillations of the design are analyzed. C.R.

A84-25802

AERODYNAMIC DISTURBANCES OF HOT-WIRE PROBES AND DIRECTIONAL SENSITIVITY

R. J. ADRIAN, R. E. JOHNSON, B. G. JONES, P. MERATI, and A. T.-C. TUNG (Illinois, University, Urbana, IL) Journal of Physics E - Scientific Instruments (ISSN 0022-3735), vol. 17, Jan. 1984, p. 62-71. Research supported by TSI, Inc. refs

Directional responses of hot-wire probes are studied experimentally, and a theory is developed which attributes pitch response to aerodynamic disturbances caused by the probe and yaw response to a combination of aerodynamic disturbances and heat transfer effects. The predicted cooling velocity has the same form as Jorgensen's equation, and the pitch coefficient, predicted in terms of the probe geometry, compares favourably with experiments using ideal probes. Comparisons with real probes indicate the limits of validity imposed by hot-wire probe tolerances. The accuracy of Jorgensen's equation for combined yaw and pitch has been measured experimentally. Author

A84-25882

A NUMERICAL ANALYSIS OF UNSTEADY SEPARATED FLOW BY DISCRETE VORTEX MODEL USING BOUNDARY ELEMENT METHOD

T. INAMURO, T. ADACHI, and H. SAKATA (Mitsubishi Heavy Industries, Ltd., Nagasaki Technical Institute, Nagasaki, Japan) IN: Finite element flow analysis; Proceedings of the Fourth International Symposium on Finite Element Methods in Flow Problems, Tokyo, Japan, July 26-29, 1982 . Tokyo/Amsterdam, University of Tokyo Press/North-Holland Publishing Co., 1982, p. 931-938. refs

A new discrete vortex method combined with a singularity method has been developed for the analysis of unsteady separated flow. The method can easily be applied to a body of complicated shape. The strength of the nascent vortex and its position are studied by considering the vortices at the surface as approximating the boundary layer and the boundary layer as detached from the separation point and growing into the shear layer. Numerical calculations are performed for a square prism with angles of attack of 0 deg, 10 deg, 20 deg, and 30 deg are found to be in good agreement with experimental data. C.D.

A84-25886

A MODIFIED TREFFTZ METHOD FOR FLUID FLOW

M. A. SHEIKH and C. PATTERSON (Sheffield, University, Sheffield, England) IN: Finite element flow analysis; Proceedings of the Fourth International Symposium on Finite Element Methods in Flow Problems, Tokyo, Japan, July 26-29, 1982 . Tokyo/Amsterdam, University of Tokyo Press/North-Holland Publishing Co., 1982, p. 973-980. refs

Steady 2D inviscid laminar flow is investigated numerically using a modified version of the method proposed by Trefftz (1926). An approximate solution based on fundamental solutions with singularities located outside the problem domain is employed, as in the regular-boundary-integral method of Patterson and Sheikh (1981). The technique developed is then applied to confined flow past a circular body, confined flow at normal incidence to a plate, and unconfined flow past an NACA airfoil. The results are presented in graphs and tables and compared to those obtained by a conventional boundary-element method or analytically. For a given discretization, both numerical methods produced good results on the interior but experienced degradation at the boundaries. While the convergences of the methods were similar, the present method requires less computation because no integrations are involved. T.K.

A84-25999#

AN ENGINEERING APPROXIMATION OF SUPERSONIC FLUTTER FOR OVERALL MISSILE CONFIGURATION

B. YANG (Shanghai Precise Mechanism Co., Shanghai, People's Republic of China) Acta Aerodynamica Sinica, no. 4, 1983, p. 99-105. In Chinese, with abstract in English.

An engineering approach is presented of flutter analysis in supersonic flow for a missile that takes the form of a tandem wing of types 'xx' and '+x'. This method applies to the missiles at Mach numbers from 1.5 to 6. The wing-body interference and wing down-wash on the tail are investigated by the interfering factor method, and the time retardation of downwash is considered. The branch mode method is used to represent the mathematical model of structure, and also deals with various degree-of-freedom combinations of the rigid motion of the overall missile with the elastic vibrations of body, wing and tail. Representative examples of the application are presented. Author

A84-26074

SPRAYING FOR TIME - ABRADABLE SEALS THE KEY

S. A. HAINES Science Dimension (ISSN 0036-830X), vol. 16, no. 1, 1984, p. 13-16.

Abradable seals are explained and a brief history of their development is given. Abradable seals are made of high-temperature-resistant composite powders, such as nickel-coated graphite, that constitute a core material coated with metal. They must abrade easily if struck by turbine blades and be soft enough to prevent engine damage should they be blown back. Research done to improve abradable seals with respect to hardness, oxidation, resistance and temperature changes is stressed. The end result is a composite powder with good insulating properties and the ability to withstand temperatures up to 850 C. C.M.

A84-26247

ACTIVE VIBRATION CONTROL OF A SINGLE MASS ROTOR ON FLEXIBLE SUPPORTS

P. E. ALLAIRE, D. W. LEWIS, and J. D. KNIGHT (Virginia, University, Charlottesville, VA) Franklin Institute, Journal (ISSN 0016-0032), vol. 315, March 1983, p. 211-222. refs

This paper considers vibration control of a single mass flexible rotor on damped flexible supports with active feedback control. Both proportional and derivative feedback control are utilized. Free vibrations and unbalance response of the rotor-control system are determined. The effect of proportional control is to increase the critical speed of rotating machinery while the effect of derivative control is to reduce the amplitude of vibration. Generally larger ratios of support stiffness to shaft stiffness require larger values of control parameters to produce given amplitudes of vibration. Author

A84-26369
FOUR-BAR MECHANISMS WITH TWO DEGREES OF FREEDOM AND PRESPECIFIED INPUT-OUTPUT BEHAVIOR [GELENKVIERECK-MECHANISMEN MIT ZWEI FREIHEITSGRADEN UND VORGEGEBENEM EIN-/AUSGANGSVERHALTEN]
R. EPPLER (Stuttgart, Universitaet, Stuttgart, West Germany) Zeitschrift fuer Flugwissenschaften und Weltraumforschung (ISSN 0342-068X), vol. 8, Jan.-Feb. 1984, p. 39-44. In German. refs

The control surfaces and flaps of small aircraft are still almost exclusively operated with the aid of mechanical mechanisms. The basic transmission element employed is the four-bar unit. The designer of the considered mechanical transmission systems utilizes at present mainly a graphical approach. Eppler and Hiller (1975) have reported a numerical procedure for the solution of the design problem. The numerical procedure has significant advantages compared to the graphical approach. The present investigation is concerned with an extension of the numerical procedure to the case in which the superposition of two input angles produces one output angle. The application of the discussed procedure is illustrated with the aid of an example involving the driving mechanism of an aileron whose position depends not only on the lateral but also on the longitudinal movement of the control stick. G.R.

A84-26374
THE DYNAMICAL BEHAVIOUR OF EXTERNALLY PRESSURIZED GAS-LUBRICATED UNLOADED POROUS JOURNAL BEARINGS
M. MALIK and C. M. RODKIEWICZ (Alberta, University, Edmonton, Canada) Institution of Mechanical Engineers, Proceedings, Part C Mechanical Engineering Science (ISSN 0263-7154), vol. 198, no. 4, 1984, p. 33-41. refs

N84-18442# Prototyp Werke, Zell (West Germany).
ECONOMIC ROUGHING AND FINISH MILLING WITH END MILLS MADE OF HIGH SPEED TOOL STEEL CLASS HSSE: HIGH COBALT ALLOYED
H. KLAMMER *In* South African Inst. for Production Engineering Fourth Seminar on Efficient Metal Forming and Machining 24 p 1982
Avail: NTIS HC A11/MF A01

Technological advances made in the manufacture of high cobalt alloyed milling cutters are illustrated. In particular, the machining of stainless steel (i.e., AISI 310, 316, etc.) and the machining of aluminum in the aircraft industry with roughing and finishing end mills are discussed. M.G.

N84-18484 Royal Aircraft Establishment, Farnborough (England).
METEOR SCATTER COMMUNICATION IN AN AIR-GROUND ENVIRONMENT
P. S. CANNON and G. RICHARDSON 19 Jul. 1983 15 p refs Presented at IEE Intern. Conf. on Antennas and Propagation, Norwich, England, Apr. 1983
(RAE-TM-RAD-NAV-224; BR89306) Avail: Issuing Activity

Experimental results from forward scattering of high frequency radio signals from meteor trails for a ground to ground link are compared with theoretical predictions, and close agreement is demonstrated. The design of a very high frequency airborne meteor scatter system is addressed and it is shown to present significant problems, different in nature from those encountered in ground based systems. It is shown that experimental studies of aircraft electromagnetic noise are required before an optimal system can be designed. The reduction in data throughput due to Faraday rotation is also described. Author (ESA)

N84-18503# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Systems and Logistics.
ACCURACY AND SPEED OF RESPONSE TO DIFFERENT VOICE TYPES IN A COCKPIT VOICE WARNING SYSTEM M.S. Thesis
J. FREEDMAN and W. A. RUMBAUGH Sep. 1983 180 p
(AD-A135595; AFIT-LSSR-89-83) Avail: NTIS HC A09/MF A01 CSCL 17B

Voice warning systems (VWS) in aircraft cockpits provide a valuable means of warning identification. Improvements in technology have made the VWS a viable addition to aircraft warning systems. This thesis was an experiment to determine the best voice type (male, female, or neutral machine) for use in a VWS for military aircraft. Different levels of engine background noise, signal to noise ratio of the warning message, and precursor delivery formats were used. The experiment had ten subjects performing a primary tracking task; at random intervals a voice warning was interjected, requiring that the subjects respond by pushing the correct button. The results of this experiment contradict some previous beliefs and findings. The male voice was associated with more accurate responses for voice warning systems in the military aircraft environment. For speed of response the results were more complicated; the male voice was generally more closely associated with faster response times for accurate responses. Author (GRA)

N84-18517# Naval Postgraduate School, Monterey, Calif.
INTERPRETATION OF A SAR (SYNTHETIC APERTURE RADAR) IMAGE OF THE BAY OF BISCAY M.S. Thesis
J. F. SOUBRIER Sep. 1983 136 p
(AD-A135981) Avail: NTIS HC A07/MF A01 CSCL 17I

On August 20, 1978, the Synthetic Aperture Radar (SAR) on board the satellite SEASAT, gave evidence of high energy internal oceanic activity at the shelfbreak in the northern part of the Bay of Biscay. Quantitive spatial measurements of internal wave patterns were correlated with conventional, quasi-synoptic in situ data and yielded phase speeds of 0.55M/S for high frequency, nonlinear internal waves, generated in groups at the canyons indenting the shelfbreak and at the time of low tide in Brest. Their periods were found to be of 70MIN and their amplitudes estimated to be 15M. Ocean swell refraction, observed on the SAR image, together with a localized significant increase in wave height detected by the SEASAT altimeter, was related to the shear of a northwestward geostrophic jet (ca. 0.5M/S) at the break. Possible operational consequences of these features are summarized as an assessment of a SAR's capability to give tactical as well as scientific real-time information on the internal ocean. Author (GRA)

N84-18584# Lowell Univ., Mass.
REATTACHMENT OF A THREE-DIMENSIONAL, INCOMPRESSIBLE JET TO AN ADJACENT AXISYMMETRIC INCLINED SURFACE Final Report, 15 Apr. 1982 - 31 Jan. 1983
E. E. NIEMI, JR. Mar. 1983 44 p
(Contract AF-AFOSR-0215-82; AF PROJ. 2307)
(AD-A136288; AFOSR-83-1225TR) Avail: NTIS HC A03/MF A01 CSCL 20D

A study was made of the fluid mechanics of a thrust reverser jet reattaching to an aircraft nozzle afterbody. The problem basically involves the Coanda effect flow of a three dimensional, incompressible jet to an adjacent axisymmetric, inclined surface. The equations were derived in integral form and programmed for numerical solution for the case of an exhaust flow with no opposing free stream flow. Test data are reported for a scale model of a nozzle afterbody exhausting against a target-type thrust reverser. Data are presented for surface pressure coefficient at various points along the model. GRA

N84-18593# Harvard Univ., Cambridge, Mass.
NUMERICAL FLUID DYNAMICS
G. BIRKHOFF 1983 279 p
(Contract N00014-75-C-0596)
(AD-A135900) Avail: NTIS HC A13/MF A01 CSCL 20D

Contents: Dynamics of Ideal Fluids; Compressibility and Viscosity; Von Neumann's Influence; Potential Flows; Sound Waves; Nonlinear One Dimensional Waves; Incompressible Viscous Flows; Lagrangian Dynamical Systems; Conformal Maps and Potential Flows; Fourier Analysis Navier-Stokes Equations; Molecular Models of Matter; 'Courant' Stability Conditions and Amplication Matrices; and Two Dimensional Airfoil Theory. GRA

N84-18599# Texas A&M Univ., College Station. Turbomachinery Labs.
ROTORDYNAMIC FORCES DEVELOPED BY LABYRINTH SEALS Annual Report, 1 Sep. 1982 - 31 Aug. 1983
D. W. CHILDS and D. L. RHODE Oct. 1983 43 p
(Contract F49620-82-K-0083; AF PROJ. 2307)
(AD-A136217; AFOSR-83-1133TR) Avail: NTIS HC A03/MF A01 CSCL 20D

Numerous tasks have been completed in developing measurement and prediction techniques for accurately determining the fluid-structure-interaction forces on labyrinth seal rotors. The best facility has been designed, fabricated, and assembled; the drive mechanism and instrumentation system have been tested. Further, various improvements to the test apparatus have been implemented. Also, the development of two basic computational approaches for predicting seal rotor forces has been successfully completed. These consist of an improved but approximate analytical model and an extensive computer program incorporating the complete Reynolds-averaged Navier-Stokes equations. The latter model solves finite difference equations in predicting the two-dimensional (axisymmetric) compressible flow in a concentric-rotor labyrinth seal cavity. Details of a corresponding incompressible flow prediction are presented and discussed. The final numerical model will allow prediction of the desired three-dimensional, eccentric-rotor flow field and the associated rotordynamic forces. GRA

N84-18606# Aeronautical Research Labs., Melbourne (Australia).
SOME ASPECTS OF THE COMPATIBILITY BETWEEN STRAIN GAUGE READOUT EQUIPMENT AND MULTI-COMPONENT WIND TUNNEL BALANCES
N. POLLOCK Jul. 1983 28 p refs
(ARL-AERO-NOTE-417; AR-002-966) Avail: NTIS HC A03/MF A01

In multicomponent strain gauge wind tunnel balances it is common to use four arm bridges of gauges arranged to produce an output from one load component and not from other load components which also cause significant strains under the gauges. This system relies on the fact that there is fundamentally one output producing pattern of strains and three nonoutput producing patterns. It is shown that interactions arise between the various strain patterns and that these interactions, and hence the balance calibration equations, are dependent on the nature of the readout equipment used. Specific precautions which must be observed to obtain 0.01% accuracy levels are investigated. Author

N84-18676# Aeronautical Research Labs., Melbourne (Australia).
THE USE OF INTERFERENCE-FIT BOLTS OR BUSHES AND HOLE COLD EXPANSION FOR INCREASING THE FATIGUE LIFE OF THICK-SECTION ALUMINIUM ALLOY BOLTED JOINTS
J. Y. MANN, A. S. MACHIN, W. F. LUPSON, and R. A. PELL Aug. 1983 56 p refs
(AR-002-973; ARL-STRUC-NOTE-490) Avail: NTIS HC A04/MF A01

Bolt holes were detected in the lower front flange of the main spar os the mirage 3 wing, so fight-by-flight fatigue test were conducted to determine the relative fatigue performance of aluminum aloy bolted joint specimens with various bolts and bushes. Compared with joints assembled with close-fit bolts in reamed holes, the ratios of lives of specimens incorporating interference-fit bolts, interference-fit bushes and cold expanded bolt holes were about 9:1, 5:1, and 3:1, respectively. Specimens with holes cold expanded followed by the installation of interference-fit brushes results in greater fatigue life with interference-fit bushes alone. It is concluded that if refurbishment requirement for the flange involves the enlargement of bolt holes to remove fatigue cracks and also the subsequent periodic nondestructive inspection of holes in service, the use of interference-fit bushes either alone or in combination with hole cole expanded should enable a satisfactory extension in fatigue life. A.R.H.

N84-18677*# National Aeronautics and Space Administration, Washington, D. C.
THE NASTRAN THEORETICAL MANUAL
Jan. 1981 944 p
(NASA-SP-221(06); NAS 1.21:221(06)) Avail: NTIS HC A99/MF A01 CSCL 20K

Designed to accomodate additions and modifications, this commentary on NASTRAN describes the problem solving capabilities of the program in a narrative fashion and presents developments of the analytical and numerical procedures that underlie the program. Seventeen major sections and numerous subsections cover; the organizational aspects of the program, utility matrix routines, static structural analysis, heat transfer, dynamic structural analysis, computer graphics, special structural modeling techniques, error analysis, interaction between structures and fluids, and aeroelastic analysis. A.R.H.

N84-18678*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
CONCEPTS FOR IMPROVING THE DAMAGE TOLERANCE OF COMPOSITE COMPRESSION PANELS
M. D. RHODES and J. G. WILLIAMS Feb. 1984 42 p refs
Presented at the 5th Conf. on Fibrous Composites in Structural Design, New Orleans, Jan. 1981
(NASA-TM-85748; NAS 1.15:85748) Avail: NTIS HC A03/MF A01 CSCL 20K

The residual strength of specimens with damage and the sensitivity to damage while subjected to an applied inplane compression load were determined for flatplate specimens and blade-stiffened panels. The results suggest that matrix materials that fail by delamination have the lowest damage tolerance capability. Alternate matrix materials or laminates which are transversely reinforced suppress the delamination mode of failure and change the failure mode to transverse shear crippling which occurs at a higher strain value. Several damage-tolerant blade-stiffened panel design concepts are evaluated. Structural efficiency studies conducted show only small mass penalties may result from incorporating these damage-tolerant features in panel design. The implication of test results on the design of aircraft structures was examined with respect to FAR requirements. A.R.H.

N84-18682*# Lockheed-Georgia Co., Marietta.
POSTOP: POSTBUCKLED OPEN-STIFFENER OPTIMUM PANELS, USER'S MANUAL
S. B. BIGGERS and J. N. DICKSON Jan. 1984 99 p refs
(Contract NAS1-15949)
(NASA-CR-172260; NAS 1.26:172260) Avail: NTIS HC A05/MF A01 CSCL 20K

The computer program POSTOP developed to serve as an aid in the analysis and sizing of stiffened composite panels that may be loaded in the postbuckling regime, is intended for the preliminary design of metal or composite panels with open-section stiffeners, subjected to multiple combined biaxial compression (or tension), shear and normal pressure load cases. Longitudinal compression, however, is assumed to be the dominant loading. Temperature, initial bow eccentricity and load eccentricity effects are included. The panel geometry is assumed to be repetitive over several bays in the longitudinal (stiffener) direction as well as in the transverse direction. Analytical routines are included to compute panel

stiffnesses, strains, local and panel buckling loads, and skin/stiffener interface stresses. The resulting program is applicable to stiffened panels as commonly used in fuselage, wing, or empennage structures. The capabilities and limitations of the code are described. Instructions required to use the program and several example problems are included. A.R.H.

N84-18683*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ENGINE CYCLIC DURABILITY BY ANALYSIS AND MATERIAL TESTING
A. KAUFMAN and G. R. HALFORD 1983 19 p refs To be presented at the 61st Meeting of the Propulsion and Energetics Panel, Lisse, Netherlands, 30 May - 1 Jun. 1984; sponsored by AGARD
(NASA-TM-83577; E-1964; NAS 1.15:83577) Avail: NTIS HC A02/MF A01 CSCL 20K

The problem of calculating turbine engine component durability is addressed. Nonlinear, finite-element structural analyses, cyclic constitutive behavior models, and an advanced creep-fatigue life prediction method called strainrange partitioning were assessed for their applicability to the solution of durability problems in hot-section components of gas turbine engines. Three different component or subcomponent geometries are examined: a stress concentration in a turbine disk; a louver lip of a half-scale combustor liner; and a squealer tip of a first-stage high-pressure turbine blade. Cyclic structural analyses were performed for all three problems. The computed strain-temperature histories at the critical locations of the combustor linear and turbine blade components were imposed on smooth specimens in uniaxial, strain-controlled, thermomechanical fatigue tests of evaluate the structural and life analysis methods. Author

N84-18685*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.
EFFECT OF CREEP IN TITANIUM ALLOY TI-6AL-4V AT ELEVATED TEMPERATURE ON AIRCRAFT DESIGN AND FLIGHT TEST
J. M. JENKINS Feb. 1984 11 p refs Prepared in cooperation with NASA, Ames Research Center
(NASA-TM-86033; H-1228; NAS 1.15:86033) Avail: NTIS HC A02/MF A01 CSCL 20K

Short-term compressive creep tests were conducted on three titanium alloy Ti-6Al-4V coupons at three different stress levels at a temperature of 714 K (825 F). The test data were compared to several creep laws developed from tensile creep tests of available literature. The short-term creep test data did not correlate well with any of the creep laws obtained from available literature. The creep laws themselves did not correlate well with each other. Short-term creep does not appear to be very predictable for titanium alloy Ti-6Al-4V. Aircraft events that result in extreme, but short-term temperature and stress excursions for this alloy should be approached cautiously. Extrapolations of test data and creep laws suggest a convergence toward predictability in the longer-term situation. Author

N84-18692# General Dynamics Corp., Fort Worth, Tex.
DEVELOPMENT OF FATIGUE AND CRACK PROPAGATION DESIGN AND ANALYSIS METHODOLOGY IN A CORROSIVE ENVIRONMENT FOR TYPICAL MECHANICALLY-FASTENED JOINTS. VOLUME 2: STATE-OF-THE-ART ASSESSMENT Final Report, May 1981 - Sep. 1982
Y. H. KIM, S. M. SPEAKER, R. P. WEI (Lehigh Univ.), and S. D. MANNING Warminster, Pa. NADC Mar. 1983 86 p
(Contract N62269-81-C-0268; F41-400)
(AD-A136415; NADC-83126-60-VOL-2) Avail: NTIS HC A05/MF A01 CSCL 20K

Navy corrosion fatigue design requirements for metallic airframes and general design practices for satisfying these requirements are briefly reviewed. The phenomenon of and mechanisms responsible for corrosion fatigue crack initiation are reviewed. The mechanisms discussed include the stress-concentration pit mechanism, the film rupture mechanism, and the preferential dissolution mechanism. Two fracture mechanics models are described and discussed for quantitatively predicting the number of cycles to corrosion fatigue crack initiation: stress-initiation life model and strain-initiation life model. Methods are also discussed for using these initiation models for spectrum loading applications. Corrosion fatigue crack propagation mechanisms are reviewed and existing models are critiqued. Propagation models evaluated include a surface reaction controlled model, a transport controlled model, and a diffusion controlled model. These models recognize hydrogen embrittlement as the overwhelming cause of corrosion fatigue propagation enhancement. Models for load-environment interaction are described and discussed, including the generalized Wheeler model, the generalized Willenborg model, the generalized Closure model and the Vroman/Chang model. GRA

N84-18713# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.
NEW ANALYTICAL METHODS FOR THE PREDICTION OF FATIGUE CRACK GROWTH UNDER REALISTIC LOADING
H. H. VANDERLINDEN, A. U. DEKONING, and C. J. LOF 22 Nov. 1982 25 p refs Submitted for publication
(Contract NIVR-1777; NIVR-1822; NIVR-1823; NIVR-1776)
(NLR-MP-82055-U) Avail: NTIS HC A02/MF A01

Analytical techniques for crack growth rate prediction are described. A model for prediction of fatigue crack growth in aluminum alloy sheet specimens subjected to service loading conditions, and the application of linear elastic fracture mechanics to three dimensional crack growth predictions under constant amplitude loading are outlined. For centrally cracked sheet specimens subjected to flight simulation loading, crack growth rate and fatigue life predictions agree very well with experimental results. The calculation of the growth of corner cracks is applicable to relatively simple fatigue loading types, such as constant amplitude loading. Crack propagation life predictions for corner and surface cracks under constant amplitude loading can be made with an accuracy of 10 % to 15 %. Use of the derivative of the stress intensity factors for obtaining the crack shape parameter is promising. Author (ESA)

N84-19608# New Mexico Univ., Albuquerque.
DEVELOPMENT OF CRITERIA FOR THE USE OF ASPHALT-RUBBER AS A STRESS-ABSORBING MEMBRANE INTERLAYER (SAMI) Final Report, Sep. 1979 - Jun. 1983
D. E. NEWCOMB and R. G. MCKEEN Tyndall AFB, Fla. AFESC Dec. 1983 150 p
(Contract F29601-81-C-0013; AF PROJ. 2054)
(AD-A137412; NMERI-TA5-11; AFESC/ESL-TR-83-50) Avail: NTIS HC A07/MF A01 CSCL 13B

This report documents over 2 years of research efforts to characterize asphalt-rubber mixtures to be used in Stress-Absorbing Membrane Interlayers (SAMI). The purpose of these SAMIs is to retard or prevent reflection cracking in asphalt-concrete overlays. Several laboratory experiments and one field trial were conducted to define significant test methods and parameters for incorporation into construction design and specification documents. Test methods used in this study included a modified softening point test, force-ductility, and Schweyer viscosity. Variables investigated included (1) Laboratory-mixing temperature; (2) Rubber type; (3) Laboratory storage time; (4) Laboratory storage condition; (5) Laboratory batch replication; (6) Laboratory mixing time; (7) Field mixing time; (8) Laboratory test temperature; (9) Force-Ductility elongation rates; and (10) Asphalt grade. It was found that mixing temperature, mixing time, rubber type, and asphalt grade all have significant effects upon the behavior of asphalt-rubber mixtures. Significant variability was also noticed in different laboratory batch replications. Varying laboratory test temperature and force-ductility elongation rate revealed further differences in asphalt-rubber mixtures. GRA

N84-19611# Kelvinator Compressor Co., Grand Rapids, Mich.
RESEARCH AND DEVELOPMENT OF ENERGY-EFFICIENT APPLIANCE MOTOR-COMPRESSORS. VOLUME 4: PRODUCTION DEMONSTRATION AND FIELD TEST
M. G. MIDDLETON and R. S. SAUBER Sep. 1983 72 p
(Contract W-7405-ENG-26)
(DE84-005083; ORNL/SUB-78-7229/4) Avail: NTIS HC A04/MF A01

Two models of a high efficiency compressor for low back pressure applications were manufactured. Many changes required production process changes. The compressors were used in top mount refrigerator freezers. The results reveal a 27.0% improvement in energy consumption for the 18 ft(3) high efficiency model and a 15.6% improvement in the 21 ft(3) improvement in the 21 ft(3) high efficiency model as compared to the standard production unit. DOE

N84-19679# Semcor, Inc., Farmingdale, N.J.
INTERFACE CONTROL DOCUMENT FOR AN/ARC-186 VHF-AM/FM RADIO
Dec. 1983 96 p
(Contract DAAB07-83-D-F058)
(AD-A136939; USAAVRADCOM-83E-13) Avail: NTIS HC A05/MF A01 CSCL 17B

This document establishes the requirements for the transfer of all data between the AN/ARC-186 and the onboard aircraft systems. The primary mode of information transfer will be via a MIL-STD-1553B data bus. Author (GRA)

N84-19681# Semcor, Inc., Farmingdale, N.J.
INTERFACE CONTROL DOCUMENT FOR RT-XXXX/ARC-164 UHF-AM RADIO
Dec. 1983 101 p
(Contract DAAB07-83-D-F058)
(AD-A136970; USAAVRADCOM-83E-10) Avail: NTIS HC A06/MF A01 CSCL 17B

This document establishes the requirements for the transfer of all data between the AN/ARC-164 and the onboard aircraft systems. The primary mode of information transfer will be via a MIL-STD-1553B data bus. Author (GRA)

N84-19754# Naval Postgraduate School, Monterey, Calif.
FLOW GENERATION IN A NOVEL CENTRIFUGAL DIFFUSER TEST DEVICE M.S. Thesis
P. VIDOS Sep. 1983 105 p
(AD-A136874) Avail: NTIS HC A06/MF A01 CSCL 20D

Recognition of the need to develop optimum diffusers for advanced centrifugal compressors, resulted in the design and manufacture of a novel low-speed test facility for centrifugal diffuser testing. The CDTD was designed to allow the flow angle and wall boundary profiles into the test diffuser to be controlled by variable geometry in the flow generator. The present study reports on the design of the flow generator and the analysis of the internal flow using a NASA computer code (MERIDL). First test results are given and are compared with the results of a control volume analysis. The flow angle control technique was found to work effectively but to give somewhat smaller angles (by 4 deg) than were predicted. It was concluded that the information obtained would allow scaling of the device; however, an analysis code was needed which would accept the real physical boundary conditions. Author (GRA)

N84-19755# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
ROUGHNESS EFFECTS ON COMPRESSOR BLADE PERFORMANCE IN CASCADE AT HIGH REYNOLDS NUMBER M.S. Thesis
F. J. TANIS, JR. Nov. 1983 112 p
(AD-A136896; AFIT/GAE/AA/83D-23) Avail: NTIS HC A06/MF A01 CSCL 20D

An experimental investigation of the effect of roughness on compressor blade performance in cascade at high Reynolds numbers was performed. A 7-blade cascade of NACA 64-A905 blades with a chord of 2 in. and aspect ratio of 1 was tested in linear cascade. The blades were mounted with a stagger angle of 31 deg and angle of attack of 15 deg. Spacing between blades was 1.33 in. which gave a solidity of 1.5. This study was divided into two parts: to determine the importance of the location of roughness on blade performance; and to determine how the degree of roughness affects blade performance. The velocity and turbulence intensity profiles of the flow region downstream of the center blade and the non-dimensional total pressure loss parameter omega bar were used to evaluate blade performance. Hot wire anemometry measured velocity and turbulence intensity profiles downstream of the blade. Measured exit velocity and static pressure were used to derive the exit total pressure. Roughness located near the leading edge of the blade caused the greatest impact on omega bar and the velocity and turbulence intensity profiles. Changes in magnitude of roughness did not affect blade performance until a threshold was exceeded; then performance decreased rapidly. GRA

N84-19760# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
PREDICTING THE ONSET OF TURBULENCE IN THE PRESENCE OF A PRESSURE GRADIENT M.S. Thesis
R. D. CHARLES Dec. 1983 74 p
(AD-A136980; AFIT/GAE/AA/83D-4) Avail: NTIS HC A04/MF A01 CSCL 20D

An analytical study is presented regarding the determination of a pressure gradient dependent criterion for flow transition from laminar to turbulent flow. The results obtained were derived from two parallel approaches to flow stability; one of wave-dependent stability and the other of vorticity-dependent stability. In both cases, one of a variable transition Reynolds number dependent upon the ambient pressure gradient and the other one of a constant transition Reynolds number bases on the boundary-layer displacement thickness, the prediction results were either as good or better than those from available prediction methods. In addition these two criteria were used to predict transition locations on a NACA 0018 airfoil, again with favorable results. Author (GRA)

N84-19765# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
THREE DIMENSIONAL/BOUNDARY LAYER INTERACTION: LAMINAR AND TURBULENT BEHAVIOUR Final Scientific Report, 1 Dec. 1981 - 30 Nov. 1982
J. J. GINOUX and G. DEGREZ 15 Dec. 1982 65 p
(Contract AF-AFOSR-0051-82; AF PROJ. 2307)
(AD-A137060; VKI-CR-1983-05; AFOSR-83-1321TR) Avail: NTIS HC A04/MF A01 CSCL 20D

An experimental study of a 3D skewed shock wave laminar boundary layer interaction has been carried out. The test configuration was a flat/finned plat arrangement with sharp leading edge fins having 4, 6 and 8 deg incidence relative to the free stream. The flat plate laminar boundary layer had thickness between 1.1 and 2.2 mm depending on test conditions. The unit Reynolds numbers used were 1.2 million and 2.4 million. Experimental surface data represented as surface flow visualizations and pressure distributions are presented for all test conditions. All tests were carried out at a nominal free stream Mach number of 2.25 and under approximately adiabatic wall conditions. The experimental results indicate that extended separation occurs even for the smallest wedge incidence, i.e., for a pressure ratio of 1.27 and that the extent of upstream influence is much larger in this 3D interaction than in comparable 2D interactions. Preliminary theoretical investigations show that an integral method is not suited for the study of the present interaction. The new implicit corrected viscosity method for solving the compressible Navier-Stokes equations can yield convergence speeds of order unity under suitable chosen conditions. Author (GRA)

N84-19774# National Aerospace Lab., Amsterdam (Netherlands). Informatics Div.
AN INFRASTRUCTURE FOR COMPUTATIONAL FLUID DYNAMICS FOR COMPUTER AIDED DESIGN
W. LOEVE 15 Sep. 1982 28 p refs In DUTCH; ENGLISH summary Presented at Symp. for Users of Finite Element Method, Delft, 3 Sep. 1982
(NLR-MP-82046-U) Avail: NTIS HC A03/MF A01

The infrastructure for information processing and the infrastructure for organizational control are discussed. Techniques are under development to support computer aided design of airplanes, ships and cars by handling the large amounts of data involved in the design process. It is shown that two aspects determine the usability of a calculation method: its properties, and the integration within the infrastructure for information processing in the organization. Author (ESA)

N84-19776# Technische Univ., Berlin (West Germany). Inst. fuer Luft- und Raumfahrt.
DEVELOPMENT OF A WIND TUNNEL TEST SECTION WITH ADAPTIVE FLEXIBLE WALLS FOR THREE-DIMENSIONAL FLOW Final Report, Oct. 1982
U. GANZER, Y. IGETA, E. KLEIN, and R. REDSTOCK Bonn Bundesministerium fuer Forschung and Technologie Oct. 1983 73 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-W-83-026; ISSN-0170-1339) Avail: NTIS HC A04/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 15,50

Adaptive wall wind tunnels for 3D transonic testing are described. A test section with eight flexible solid walls with shape adaptable to streamline curvature was built. A computer program was developed to calculate a 3D wall contour from a measured 3D wall pressure distribution and an automatic control device for adjusting and controlling the wall positions was also developed. Pressure measurements using a body of revolution and three-component force measurements for a wing body combination were made. Test results confirm the constructional conception and the working principle of the system. Author (ESA)

N84-19814*# Control Dynamics Co., Huntsville, Ala.
EFFECTS OF BEARING DEADBANDS ON BEARING LOADS AND ROTOR STABILITY Final Report
20 Jan. 1984 198 p refs
(Contract NAS8-35050)
(NASA-CR-170986; NAS 1.26:170986) Avail: NTIS HC A09/MF A01 CSCL 13I

A generic model of a turbopump, simplified to bring out these effects is examined. This model demonstrates that bearing deadbands which are of the same order of magnitude or larger than the center-of-mass offset of a rotor due to mass imbalances cause significantly different dynamic behavior than would be expected of a linear, dynamical system. This fundamentally nonlinear behavior yields altered stability characteristics and altered bearing loading tendencies. It is shown that side forces can enhance system stability in the small, i.e., as long as the mass imbalance does not exceed some thresholds value or as long as no large, impulsive disturbances cause the motion to depart significantly from the region of stability. Limit cycles are investigated in this report and techniques for determining these limit cycles are developed. These limit cycles are the major source of bearing loading and appear in both synchronous and nonsynchronous forms. The synchronous limit cycles are driven by rotor imbalances. The nonsynchronous limit cycles (also called subsynchronous whirls) are self-excited and are the sources of instability. Author

N84-19829# Institute for Defense Analyses, Alexandria, Va. Science and Technology Div.
STRUCTURAL COMPOSITES TECHNOLOGY WORKING GROUP REPORT IDA/OSD R AND M (INSTITUTE FOR DEFENSE ANALYSES/OFFICE OF THE SECRETARY OF DEFENSE RELIABILITY AND MAINTAINABILITY) STUDY Final Report, Jul. 1982 - Aug. 1983
F. CROSSMAN (Lockheed Missiles and Space Co.) Aug. 1983 164 p
(Contract MDA903-79-C-0018)
(AD-A137331; AD-E500605; IDA-D-31; IDA/HQ-83-25897) Avail: NTIS HC A08/MF A01 CSCL 15C

This document records the activities and presents the findings of the Structural Composites Technology Working Group, part of the IDA/OSD Reliability and Maintainability Study, conducted during the period from July 1982 through August 1983. GRA

N84-19849# Shock and Vibration Information Center (Defense), Washington, D. C.
THE SHOCK AND VIBRATION DIGEST, VOLUME 15, NO. 8 Monthly Report
J. NAGLE-ESHLEMAN, ed. Aug. 1983 86 p refs
(AD-A133708) Avail: SVIC, Code 5804, Naval Research Lab., Washington, D.C. 20375 CSCL 20K

Equivalence techniques for vibration testing are discussed. Different tests are surveyed. Vibration exposure is discussed. Stability problems of rotor systems and general vibration problems due to free and forced vibrations are discussed. Abstracts are given on such topics as acoustic excitation, structural analysis, shafts, and pumps.

N84-19851# Kobe Univ. (Japan).
STABILITY PROBLEMS OF ROTOR SYSTEMS
T. IWATSUBO *In* the Shock and Vibration Digest, Vol. 15, No. 8 p 13-24 Aug. 1983 refs
Avail: SVIC, Code 5804, Naval Research Lab., Washington, D.C. 20375 CSCL 20K

A review of the literature published from 1980 to 1982 on vibration problems in rotor dynamics, especially instability problems is given. Included are general vibration problems and theoretical and numerical approaches to free and forced vibrations; vibration problems of turbines, compressors, pumps, and bearings; flow-induced forces due to seals and impellers; parametric excitations due to couplings and unsymmetric stiffness of rotor shafts; torsional vibration; gears; monitoring (diagnosis); and control. R.J.F.

N84-19866# Shock and Vibration Information Center (Defense), Washington, D. C.
THE SHOCK AND VIBRATION BULLETIN. PART 1: WELCOME, KEYNOTE ADDRESS, INVITED PAPERS, PYROTECHNIC SHOCK, AND SHOCK TESTING AND ANALYSIS Monthly Report
May 1983 196 p refs Proc. of the 53d Symp. on Shock and Vibration, Danvers, Mass., 26-28 Oct. 1982 4 Vol.
(AD-A134452; SVIC-BULL-53-PT-1) Avail: SVIC, Code 5804, Naval Research Lab., Washington, D.C. 20375 CSCL 20K

Interchange of information in the shock and vibration field between government, industry and universities is stressed. Topics of discussion included pyrotechnic shock, shock testing, shock analysis, and aircraft survivability.

N84-19881# Shock and Vibration Information Center (Defense), Washington, D. C.
THE SHOCK AND VIBRATION BULLETIN. PART 2: FLUID-STRUCTURE DYMANICS AND DYNAMIC ANALYSIS Monthly Report
May 1983 157 p refs Proc. of the 53d Symp. on Shock and Vibration, Danvers, Mass., 26-28 Oct. 1982 4 Vol.
(AD-A134453; SVIC-BULL-53-PT-2) Avail: SVIC, Code 5804, Naval Research Lab., Washington, D.C. 20375 CSCL 20K

Work influence structure dynamics are reported. Partial Contents: experimental validation of the component synthesis

method for predicting vibration of liquid filled piping; acoustic responses of coupled fluid structure system by acoustic structural analog; fluid structure interaction by the method of characteristics; a solution to the axisymmetric and one dimensional bulk cavitation problem; dynamic simulation of structural systems with nonlinear components; experimental and analytical investigation of active loads control for aircraft landing gear; modal identification of multiple degree of freedom systems from experimental data; an application of the kinetic energy calculation as an aid in mode identification; dynamics of a simple system subjected to random impact; approximate numerical predictions of impact induced structural responses; face shear vibrations of contoured crystal plates; and dynamic behavior of composite layered beams by the finite element method.

N84-19888# Hughes Helicopters, Culver City, Calif.
APPLICATION OF THE KINETIC ENERGY CALCULATION AS AN AID IN MODE IDENTIFICATION
J. J. BROWN and G. R. PARKER *In* Shock and Vibration Inform. Center The Shock and Vibration Bull., part 2 p 111-123 May 1983 refs
Avail: SVIC, Code 5804, Naval Research Lab., Washington, D.C. 20375 CSCL 20K

The ability to economically and efficiently solve large order finite element dynamic problems has become a reality. The task of modal identification, however, has proportionately increased. By applying the kinetic energy calculation to the modal data, candidates for structural and local modes and possible modeling errors can be quickly isolated. This technique was applied during the analysis of the Hughes Advanced Attack Helicopter (AAH). The obvious advantages offered by this method are shown. E.A.K.

N84-19912# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio. Materials Lab.
A VIBRATION DAMPING TREATMENT FOR HIGH TEMPERATURE GAS TURBINE APPLICATIONS
A. D. NASHIF (Anatrol Corp.), W. D. BRENTNALL (Solar Turbines, Inc.), and D. I. G. JONES *In* Shock and Vibration Inform. Center The Shock and Vibration Bull., part 4 p 29-40 May 1983 refs
Avail: SVIC, Code 5804, Naval Research Lab., Washington, D.C. 20375 CSCL 20K

An investigation of the behavior and properties of a family of vitreous enamels designed to give high damping properties when applied as coatings to high temperature static components in gas turbine engines is discussed. Complex modulus properties and effects of thermal aging are discussed. R.J.F.

N84-19918# Institut National des Sciences Appliquees de Lyon, Villeurbanne (France). Lab. de Mecanique des Structures.
PREDICTION OF CRITICAL SPEEDS, UNBALANCE AND NONSYNCHRONOUS FORCED RESPONSE OF ROTORS
P. BERTHIER, G. FERRARIS, and M. LALANNE *In* Shock and Vibration Inform. Center The Shock and Vibration Bull., part 4 p 103-111 May 1983 refs
Avail: SVIC, Code 5804, Naval Research Lab., Washington, D.C. 20375 CSCL 20K

The dynamic behavior of rotors must be accurately predicted today at the design stage of construction of rotating machinery. Here the general equations of rotors consisting of symmetric shafts, rigid discs and nonsymmetric bearings are presented. These equations are obtained by using a finite element technique and solved with a modal method. Two industrial applications, a gas turbine and a centrifugal compressor, are presented for which the critical speeds, unbalance and nonsynchronous forced response are calculated. Author

N84-19919# Concordia Univ., Montreal (Quebec). Dept. of Mechanical Engineering.
UNBALANCE RESPONSE OF A SINGLE MASS ROTOR MOUNTED ON DISSIMILAR HYDRODYNAMIC BEARINGS
R. SUBBIAH, R. B. BHAT, and T. S. SANKAR *In* Shock and Vibration Inform. Center The Shock and Vibration Bull., part 4 p 113-125 May 1983 refs
Avail: SVIC, Code 5804, Naval Research Lab., Washington, D.C. 20375 CSCL 13H

The critical speeds and unbalance response of a single mass rotor, mounted on dissimilar fluid-film bearings at the ends, are studied. The direct and cross-coupled coefficients of stiffness and damping at the bearings are included in the analysis, which are expressed as polynomials in Sommerfeld number. The equations of motion are obtained by Lagrangian approach. The resulting equations of motion are solved to obtain the unbalance response and critical speeds. Numerical results are obtained for a laboratory model of a single mass rotor and the effects of various parameters of the system on the response are investigated. The response of the rotor at the bearing locations are also obtained. Author

N84-19927*# Akron Univ., Ohio. Dept. of Mechanical Engineering.
EXPERIMENTAL STUDY OF UNCENTRALIZED SQUEEZE FILM DAMPERS
R. D. QUINN Dec. 1983 127 p refs
(Contract NSG-3283; NAG3-50)
(NASA-CR-168317; NAS 1.26:168317; NAUFP-202-2) Avail: NTIS HC A07/MF A01 CSCL 20K

The vibration response of a rotor system supported by a squeeze film damper (SFD) was experimentally investigated in order to provide experimental data in support of the Rotor/Stator Interactive Finite Element theoretical development. Part of the investigation required the designing and building of a rotor/SFD system that could operate with or without end seals in order to accommodate different SFD lengths. SFD variables investigated included clearance, eccentricity mass, fluid pressure, and viscosity and temperature. The results show inlet pressure, viscosity and clearance have significant influence on the damper performance and accompanying rotor response. Author

N84-19931# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
NUMERICAL DETERMINATION OF THE EFFECTS OF BOUNDARY CONDITIONS ON THE INSTABILITY OF COMPOSITE PANELS WITH CUTOUTS M.S. Thesis
C. E. LEE Dec. 1983 141 p
(AD-A136772; AFIT/GA/AA/83D-4) Avail: NTIS HC A07/MF A01 CSCL 20K

An analytical study using the STAGSC-1 computer code was conducted to determine the effects of notches and unsymmetric boundary conditions on the load bearing capability and radial displacements of axially loaded cylindrical panels. The graphite-epoxy panel consisted of an 8 ply laminate with symmetric ply orientations. A finite element mesh refinement in the vicinity of the cutout was conducted in order to study the non-linear collapse analysis. In addition, the effect of different size cutouts with aspect ratios (axial dimension of cutout divided by circumferential dimension) of 2.0 or 0.5 was studied. Finally, analytic results for a 2 in. x 2 in. cutout with a varying set of boundary conditions were compared to experimental findings. It was found that as the surface area of the cutout increased, the buckling load decreased. Cutouts with aspect ratios of 2.0 were found to be capable of carrying higher loads than notches with an aspect ratio of 0.5. By comparing analytic results with experimental data, it was found that unsymmetric boundary conditions for the 2 in. x 2 in. cutout better approximated experimental data than when symmetric boundary conditions were considered. GRA

13

GEOSCIENCES

Includes geosciences (general); earth resources; energy production and conversion; environment pollution; geophysics; meteorology and climatology; and oceanography.

A84-23424* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SIXTH ANNUAL WORKSHOP ON METEOROLOGICAL AND ENVIRONMENTAL INPUTS TO AVIATION SYSTEMS, 26-28 OCTOBER 1982, TULLAHOMA, TENN
D. W. CAMP (NASA, Marshall Space Flight Center, Huntsville, AL), W. FROST (Tennessee, University, Tullahoma, TN), F. COONS (FAA, Washington, DC), P. EVANICH (NASA, Lewis Research Center, Cleveland, OH), and C. H. SPRINKLE (NOAA, National Weather Service, Silver Spring, MD) American Meteorological Society, Bulletin (ISSN 0003-0007), vol. 65, Jan. 1984, p. 44-47. refs

The six workshops whose proceedings are presently reported considered the subject of meteorological and environmental information inputs to aviation, in order to satisfy workshop-sponsoring agencies' requirements for (1) greater knowledge of the interaction of the atmosphere with aircraft and airport operators, (2) a better definition and implementation of meteorological services to operators, and (3) the collection and interpretation of data useful in establishing operational criteria that relate the atmospheric science input to aviation community operations. Workshop topics included equipment and instrumentation, forecasts and information updates, training and simulation facilities, and severe weather, icing and wind shear. O.C.

A84-23647#
THE ICING OF AN UNHEATED, NONROTATING CYLINDER. I - A SIMULATION MODEL
E. P. LOZOWSKI, J. R. STALLABRASS, and P. F. HEARTY (National Research Council, Low Temperature Laboratory, Ottawa, Canada) Journal of Climate and Applied Meteorology (ISSN 0733-3021), vol. 22, Dec. 1983, p. 2053-2074. Research supported by the National Research Council of Canada; Natural Sciences and Engineering Research Council. refs
(Contract NSERC-A-8168)

The thermodynamic conditions and the initial icing rate are computed as a function of the angle around the upstream face of the cylinder. Even though the model is not time-dependent, the initial icing rate can be used to compute local ice thickness after a specified time interval, and these in turn make it possible to plot the ice accretion profile in either a single-step or a multistep fashion. In this way, it is possible to predict the total ice accretion cross-sectional area and mass for ice grown under varying conditions of airspeed, air temperature and pressure, cloud liquid water content, droplet size distribution, and cylinder size. An experimental investigation is then carried out of icing on nonrotating cylinders under both wet and dry conditions. The airspeeds are 30, 61, and 122 m/s; the liquid water contents are 0.4, 0.8, and 1.2 g/cu m; and the temperatures are -15, -8, and -5 C. The model is found to perform best under dry growth conditions. Under wet conditions, the model, while qualitatively correct, is not able to exactly duplicate the details of the accretion profiles. C.R.

A84-24055#
OPTIMUM PROPELLER WIND TURBINES
R. J. SANDERSON and R. D. ARCHER (New South Wales, University, Kensington, Australia) Journal of Energy (ISSN 0146-0412), vol. 7, Nov.-Dec. 1983, p. 695-701. refs

The Prandtl-Betz-Theodorsen theory of heavily loaded airscrews has been adapted to the design of propeller windmills which are to be optimized for maximum power coefficient. It is shown that the simpler, light-loading, constant-area wake assumption can generate significantly different 'optimum' performance and geometry, and that it is therefore not appropriate to the design of propeller wind turbines when operating in their normal range of high-tip-speed-to-wind-speed ratio. Design curves for optimum power coefficient are presented and an example of the design of a typical two-blade optimum rotor is given. Author

A84-25876
INITIALIZATIONS FOR NUMERICAL WEATHER PREDICTION BASED ON FINITE ELEMENT METHOD
W.-J. LIANG, C.-C. WANG, and C.-S. SHJEH (Academia Sinica, Institute of Physics, Nankang, Republic of China) IN: Finite element flow analysis; Proceedings of the Fourth International Symposium on Finite Element Methods in Flow Problems, Tokyo, Japan, July 26-29, 1982 . Tokyo/Amsterdam, University of Tokyo Press/North-Holland Publishing Co., 1982, p. 851-858. refs

It is noted that if the biased interpolated field is used as initial data for simulation, undesirable high-frequency noises may be generated. Before simulation, therefore, the interpolated field must be adjusted in such a way that the pressure and wind field are approximately balanced. This procedure is referred to as initialization. To eliminate the bias caused by the objective analysis, two initialization schemes based on finite element methods are investigated. The observation stations are taken as element nodes; in this way, the conventional objective analysis is bypassed. It is pointed out that these initialization schemes derive from the variational objective analysis of Sasaki (1958, 1970). In the first scheme, the geostrophic balance approximation serves as the weak constraints. In the second, the linear balance approximation is used as the strong constraint. C.R.

N84-18811# Federal Aviation Administration, Washington, D.C. Office of Aviation Policy and Plans.
ESTABLISHMENT AND DISCONTINUANCE CRITERIA FOR AUTOMATED WEATHER OBSERVING SYSTEMS (AWOS) Final Report
W. L. KEECH May 1983 168 p
(AD-A135674; FAA-APO-83-6) Avail: NTIS HC A08/MF A01 CSCL 04B

This report develops establishment and discontinuance criteria for automated weather observing systems (AWOS) for publication in FAA Order 7031.2B, Airway Planning Standard Number One. Airway Planning Standard Number One contains the policy and summarizes the criteria used in determining eligibility of terminal locations for establishment, discontinuance and improvements of air navigation facilities and air traffic control services. The criteria developed in this report are based on rigorous life-cycle cost effectiveness and benefit/cost analyses of AWOS which measure weather and environmental parameters essential to FAA operations--wind direction and speed, temperature and dew point, altimeter setting, ceiling, visibility, precipitation and thunderstorm activity. Author (GRA)

N84-18813# California State Univ., Northridge.
PRELIMINARY STUDY FOR THE MODELING OF AN ARTIFICIAL ICING CLOUD Final Report, Oct. 1982 - Aug. 1983
M. EPSTEIN, S. MOINI, G. THIELMAN, and J. VILJA Edwards AFB, Calif. Air Force Flight Test Center Aug. 1983 50 p
(Contract F04700-83-M-0054; AF PROJ. 6320)
(AD-A135717; AFFTC-TIM-83-4) Avail: NTIS HC A03/MF A01 CSCL 04A

An evaluation was made of the essential features required to generate an effective model of an artificial icing cloud. Several alternatives were considered. A turbulent mixing length/integral method approach appears to be the most promising. A preliminary version of the fluid mechanical aspects of this model was developed and found to predict overall cloud sizes comparable to those observed during flight tests. Calculations of the radial velocity distributions in the cloud suggest that radial stratification of droplets according to size may occur (large droplets near the periphery and small droplets near the center). Recommendations for future work are included. Author (GRA)

N84-18814# California State Univ., Northridge. Dept. of Mechanical and Chemical Engineering.
REVIEW AND ASSESSMENT OF USAF AND US ARMY (HISS) ARTIFICIAL ICING CLOUD STUDIES Final Report
H. C. JI, S. H. SCHWARTZ, M. R. MIRKHANI, and S. SHAPOURI Edwards AFB, Calif. AFFTC Mar. 1983 65 p
(Contract F04700-83-M-0052; AF PROJ. 6320)
(AD-A135720; AFFTC-TIM-83-2) Avail: NTIS HC A04/MF A01 CSCL 04A

Artificial clouds were generated by an airplane or a helicopter spraying water through a bank of nozzles towed directly behind the aircraft. A trailing test aircraft was flown into the spray cloud; icing was induced on various surfaces of the test aircraft by exposing selected surfaces. In the flight tests conducted in the late 1970's, it was found that the droplets from the artificial cloud were too large, and the clouds were too small in size. In order to reduce the droplet size extensive work was performed in the NASA Lewis icing wind tunnel to select a more appropriate nozzle to achieve smaller droplet sizes, and to evaluate the effects of nozzle orientation and various flow parameters on the nature of artificially generated clouds. A design clinic team of graduate students has undertaken a study of the USAF inflight and wind tunnel test programs. The purpose of this study was to review the accumulated data and the experimental methods involved. An attempt was made to evaluate the quality, validity, and the direction of the work performed thus far, and to suggest ways to improve the experimental procedure and possibly present fresh ways to view the problem. GRA

N84-18816# Naval Oceanography Command Detachment, Asheville, N.C.
CLIMATIC PUBLICATIONS
Nov. 1983 13 p
(AD-A136021) Avail: NTIS HC A02/MF A01 CSCL 04B

These summaries constitute a series of compilations which are world-wide in scope. It consists of climatological summaries for selected airfields and for the climatic areas in which they are located. The series includes data for approximately 4,000 stations and consist of 12 volumes. Copies of these volumes are available from the Defense Technical Information Center (DTIC) or the National Technical Information Service (NTIS). The pages are generally self-explanatory with an introduction in each volume. In this summary series, the period of record varies considerably for any given station between particular elements summarized. For example, the period of record for temperature may not be the same as that for cloud cover. This fact renders the normal use of numbers in the columns under the summaries meaningless. Hence, a letter is utilizied under the World-wide Airfield Summary Column in an attempt to provide the specific volume of the series in which a station is located. GRA

N84-18818# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
CURRENT PROCEDURES FOR FORECASTING AVIATION ICING: A REVIEW
W. B. TUCKER, III Aug. 1983 36 p
(Contract DA PROJ. 4A1-61102-AT-24)
(AD-A136152; CRREL-SR-83-24) Avail: NTIS HC A03/MF A01 CSCL 04B

The responsibilities for aircraft icing forecasts in the U.S. lie with the National Weather Service (NWS) for civilian operations and the U.S. Air Force Air Weather Service (AWS) and Naval Weather Service for military operations. Forecasting technology is based upon empirical rules and techniques that were developed in the 1950s. The AWS is the only forecasting agency which issues explicit numerical icing products to aid the forecaster. These products are also based upon the application of techniques developed long ago. The NWS has no rigorous guidelines for developing icing forecasts, thus individual forecasters adopt their own preferred methods. The tendency is generally to 'over-forecast', that is, to forecast too large an area of icing for too long a time. A major shortcoming in the ability to produce more accurate forecasts is that atmospheric parameters critical to icing are not routinely observed. Author (GRA)

N84-20031# Air Force Engineering and Services Center, Tyndall AFB, Fla. Environmental Sciences Branch.
AIRCRAFT GENERATION EQUIPMENT EMISSIONS ESTIMATOR (AGEEE) Final Report, Jul. - Aug. 1983
G. D. SEITCHEK, D. D. BERLINRUT, and L. A. RAMOS Nov. 1983 36 p
(Contract AF PROJ. 2103)
(AD-A136829; AFESC/ESL-TR-83-48) Avail: NTIS HC A03/MF A01 CSCL 21B

This report is designed to serve as a handbook for computing emissions from aircraft generation equipment (AGE), both by hand and by using a microcomputer. Emissions factors and the required equations are provided, along with examples which illustrate how to perform the calculations. The techniques described in the report are approximations, and should only be used for estimating emissions. Author (GRA)

N84-20087# Air Force Geophysics Lab., Hanscom AFB, Mass.
ANALYSIS OF AFGL AIRCRAFT ICING DATA
I. D. COHEN 5 Jul. 1983 48 p
(Contract AF PROJ. 6670)
(AD-A137197; AFGL-TR-83-0170; AFGL-ERP-843) Avail: NTIS HC A03/MF A01 CSCL 04B

Data from 25 flights by a MC-130E aircraft were used to check the weather forecasting accuracy of icing conditiions. Icing was observed in about 70 to 80 percent of the cases in which heavy or moderate icing was indicated, and 30 to 40 percent of those in which no icing was indicated. The data were examined as a function of altitude and temperature. Author

15

MATHEMATICAL AND COMPUTER SCIENCES

Includes mathematical and computer sciences (general); computer operations and hardware; computer programming and software; computer systems; cybernetics; numerical analysis; statistics and probability; systems analysis; and theoretical mathematics.

A84-24999*# Technion - Israel Inst. of Tech., Haifa.
USING INTEGRALS OF THE STATE TRANSITION MATRIX FOR EFFICIENT TRANSIENT-RESPONSE COMPUTATIONS
A. J. GRUNWALD (Technion - Israel Institute of Technology, Haifa, Israel) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 7, Mar.-Apr. 1984, p. 252-254. refs
(Contract NASW-3302)

An iterative technique for the computation of lower-order state systems with poles at the origin (such as aircraft lateral dynamics) or with time-polynomial inputs is developed and demonstrated. The integrated input or output signals are computed using the integrals of the state transition matrix, thus reducing the system order and computation time. In an application to the lateral response of a DC-8 aircraft (Grunwald, 1981), this method required only 7824 multiplication or addition operations (at fourth order) to achieve the accuracy obtained in 15,012 operations by a conventional sixth-order computation. D.G.

A84-25451
AMERICAN CONTROL CONFERENCE, SAN FRANCISCO, CA, JUNE 22-24, 1983, PROCEEDINGS. VOLUMES 1, 2 & 3
Conference sponsored by the American Automatic Control Council. New York, Institute of Electrical and Electronics Engineers, 1983, Vol. 1, 392 p.; vol. 2, 541 p.; vol. 3, 505 p.

The present conference covers the topics of computers in industrial process control, the dynamic modeling of power plants with the Modular Modeling System, automotive and off-highway vehicle control systems, estimation methods, computer-aided

control engineering, the design of controllers for nonlinear systems, the modeling and control of nuclear reactors, distillation column control, the application of control technologies to the problems of the disabled, and energy management and control applications. Also discussed are the dynamics and control of ground vehicles, distributed estimation techniques, key issues and case studies in computer-aided control engineering, nonlinear systems, process model-based control, control aspects of photovoltaic energy systems, novel perspectives in power flow analysis, model reduction methods, estimation in multitarget environments, the dynamic analysis and control of manipulators, flight control, stability and control issues in power systems, recent study results for the modeling and control of large scale systems, digital control techniques, the design and control of robots, self-tuning and adaptive control applications, linear multivariable techniques, fault detection and diagnosis in continuous systems, the modeling and identification of flexible structures, optimal control, robotics and industrial automation, missile guidance and control systems, multiagent decision problems, computer process control, linear system theory, stochastic control and fault detection, fuzzy logic and systems, and robust control. O.C.

A84-25452
WIND SHEAR ESTIMATION BY FREQUENCY-SHAPED OPTIMAL ESTIMATOR
B. K. KIM and J. A. BOSSI (Washington, University, Seattle, WA) IN: American Control Conference, San Francisco, CA, June 22-24, 1983, Proceedings. Volume 1 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 92-96. Research supported by the Boeing Commercial Aircraft Co. refs

This paper presents a formulation of the frequency shaped optimal estimator and investigates the role of the measurement noise shaping function in this estimator. This shaping function creates transmission zeros and affects the singular values of the estimator transfer matrix, which can be used to improve control system robustness. The resulting estimator design technique has been applied to the estimation of wind shear on-board an airplane, and its performance has been simulated and compared with a reference Kalman filter. Author

A84-25491* Rensselaer Polytechnic Inst., Troy, N. Y.
MODEL REFERENCE ADAPTIVE CONTROL FOR SYSTEMS WITH TIME VARYING MODEL COMMANDS
L. ABIDA and H. KAUFMAN (Rensselaer Polytechnic Institute, Troy, NY) IN: American Control Conference, San Francisco, CA, June 22-24, 1983, Proceedings. Volume 2 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 548-552. refs
(Contract NSF ECS-80-16173; NAG1-171)

Model reference adaptive control is applied to linear time invariant systems for the case of arbitrary time varying model commands. Asymptotic stability is guaranteed, provided that the output stabilized transfer matrix is strictly positive real. Only output measurements are needed. Neither perfect model following nor explicit parameter identification is required. Simulations show the scheme to be capable of guaranteeing stability when the model inputs are time varying. Author

A84-25510
DIGITAL CONTROL LOADING - A MODULAR APPROACH
P. RINALDI and K. BECKHAM (Reflectone, Inc., Tampa, FL) IN: American Control Conference, San Francisco, CA, June 22-24, 1983, Proceedings. Volume 2 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 803-806.

The basic design and capabilities of a high-quality digital feedback control system recently developed for use in flight simulators to control forces generated by a hydrostatic actuator-based flight control system are presented. Steps taken during design and development to insure a low cost, low maintenance, highly reliable system capable of extremely high fidelity simulation of a wide variety of aircraft are pointed out. Block diagrams of the subsystems are presented, and performance is discussed showing force vs displacement and displacement vs time plots. C.D.

A84-25513
EXACT MULTI-INPUT POLE PLACEMENT BY LINEAR-QUADRATIC SYNTHESIS
J. K. HEDRICK and K. YOUCEF-TOUMI (MIT, Cambridge, CA) IN: American Control Conference, San Francisco, CA, June 22-24, 1983, Proceedings. Volume 3 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 905-911. refs

It is shown that, by proper selection of the weighting matrices of a quadratic performance index, that a multiinput control gain matrix can be computed that places the n poles of a controllable linear system at arbitrary locations in the left half plane. The resulting Riccati equation reduces to a set of homogeneous linear algebraic equations. A robust computational program is developed and illustrated on simple as well as larger-order MIMO systems. C.D.

A84-25519
COMPARISON OF INNOVATIONS-BASED ANALYTICAL REDUNDANCY METHODS
A. MADIWALE and B. FRIEDLAND (Singer Co., Kearfott Div., Little Falls, NJ) IN: American Control Conference, San Francisco, CA, June 22-24, 1983, Proceedings. Volume 3 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 940-945. refs

This paper discusses and compares two methods for estimating bias transitions in normal-mode Kalman filters and for correcting state estimates: the first is the maximum likelihood method developed by Friedland (1979) and the second is the generalized likelihood ratio (GLR) method of Willsky and Jones (1976). After a review of the underlying theory and algorithms a simulation study is reported in which the two algorithms are tested on a dynamic model of the pitch motion of an aircraft that was used in an earlier study by Friedland. Both algorithms are found to work very well when the failure amplitude is at a 10-sigma level (where sigma is the rms noise present on the sensor). The GLR method, which is more complex and requires more computer memory to implement, however, performs substantially better than the simpler maximum likelihood method at a failure amplitude of 2-sigma. Several possibilities for combining the best features of each algorithm are suggested. Author

A84-25538* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SYMMETRIC LINEAR SYSTEMS
J. LEWIS (NASA, Ames Research Center, Moffett Field, CA) and C. MARTIN (Case Western Reserve University, Cleveland, OH) IN: American Control Conference, San Francisco, CA, June 22-24, 1983, Proceedings. Volume 3 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 1182, 1183. refs
(Contract NAG2-82; NSG-2384; DE-AC01-80RA-50256)

Employment as a means of transportation in the civilian construction trades represents one of the many applications of the helicopter. However, a major limitation to its use in heavy construction has been that the mass which can be effectively and safely transported is severely restricted. The construction of the so-called 'heavy lift' helicopter provided one solution to this problem. But it has been found that there are physical and economic limitations to the payload which can be transported. The proposal has been made to overcome these limitations by making use of multiple helicopters to move a single mass. A study of the feasibility of this proposal showed that automatic control would be needed to make the concept successful. The present investigation is concerned with some initial models in regard to the twinlift problem, taking into account the control theoretic problems. G.R.

A84-25539

SUBOPTIMAL CONTROL OF A CLASS OF STOCHASTIC SYSTEMS WITH RANDOM, PARTIALLY OBSERVABLE PARAMETERS

M. H. LEE, W. J. KOLODZIEJ, and R. R. MOHLER (Oregon State University, Corvallis, OR) IN: American Control Conference, San Francisco, CA, June 22-24, 1983, Proceedings. Volume 3 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 1200-1204. refs

(Contract N00014-81-K-0814)

The control of a linear system with random coefficients is studied here. The cost function is of a quadratic form and the random coefficients are assumed to be partially observable by the controller. The optimal control is shown to be a linear function of the observable states and a nonlinear function of random parameters. An application to the landing process of an aircraft in gust wind is presented. Author

A84-25540

IMPLEMENTATION OF FAILURE-DETECTION SYSTEMS WITH ADAPTIVE OBSERVERS

M. SIDAR (Raphael Armament Development Authority, Haifa, Israel) IN: American Control Conference, San Francisco, CA, June 22-24, 1983, Proceedings. Volume 3 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 1205-1211. refs

The design problem of adaptive observers for failure-detection purposes, applied to linear, constant and possibly variable parameters, multi-input, multi-output systems is considered here. It is shown that, in order to keep the observer's (or Kalman filter) false-alarm rate (FAR) under a certain specified value, it is necessary to have an acceptable proper matching between the observer, (or KF) model and the system parameters. An adaptive observer algorithm is introduced here in order to maintain the desired system-observer model matching, despite initial mismatching and/or system parameter variations. Only a properly designed adaptive observer is able to detect abrupt changes in the system (actuator, sensor failures, etc.) with adequate reliability and FAR. Conditions for convergence for the adaptive and tracking process are obtained, leading to a simple adaptive law (algorithm) with the possibility of an a priori choice of fixed adaptive gains. Simulation results show good tracking performance with small observer output errors and accurate and fast parameter identification, in both deterministic and stochastic cases, leading to small FAR. Author

N84-18955# RAND Corp., Santa Monica, Calif.

STRATEGIES OF COOPERATION IN DISTRIBUTED PROBLEM SOLVING Interim Report

S. CAMMARATA, D. MCARTHUR, and R. STEEB Oct. 1983 31 p

(Contract MDA903-82-C-0061; ARPA ORDER 3460)

(AD-A136527; AD-F300360; RAND/N-2031-ARPA) Avail: NTIS HC A03/MF A01 CSCL 06D

Distributed artificial intelligence is concerned with problem solving that is done by groups of agents. This note describes strategies of cooperation that groups require to solve shared tasks effectively. We discuss such strategies first in a domain independent fashion, and then in the context of a specific group problem solving application: collision avoidance in air traffic control. We begin by contrasting the methodologies, difficulties, and opportunities of distributed and centralized problem solving. From this analysis, we infer a set of requirements on the information gathering and organizational policies of group problem solving agents. We then discuss a set of distributed problem solvers that we have developed in the domain of air traffic control and describe some experimental findings with the cooperative strategies used. In particular, we note large task dependent differences in processing times, communication loads, and system errors between the several cooperative strategies. Author (GRA)

N84-18987# California Univ., Los Angeles. Dept. of System Science.

RESEARCH ON BOUNDARY FEEDBACK AND CONTROL THEORIES, 1978 - 1983 Final Report, 2 Jan. 1982 - 31 Mar. 1983

A. V. BALAKRISHNAN Mar. 1983 16 p

(Contract AF-AFOSR-3550-78; AF PROJ. 2304)

(AD-A136531; AFOSR-83-1240TR) Avail: NTIS HC A02/MF A01 CSCL 12A

During the period of this grant, topics investigated included: nonlinear white noise theory; stabilization of distributed parameter systems by boundary feedback; system modeling and identification; control of flexible flight vehicles; random fields, filtering and estimation; control of randomly varying systems; and control of large space structures. Thirty technical papers were produced with titles including: active control of airfoils in unsteady aerodynamics; identification of aircraft parameters in turbulence with nonrational spectra; Aircraft performance modelling, theory and some preliminary results; and active control of large flexible space structures. GRA

N84-19011# National Aerospace Lab., Amsterdam (Netherlands). Informatics Div.

MULTIGRID METHODS FOR BOUNDARY INTEGRAL EQUATIONS

H. SCHIPPERS Dec. 1982 20 p refs Submitted for publication

(NLR-MP-82059-U) Avail: NTIS HC A02/MF A01

Multigrid methods are applied to algebraic systems of equations that occur in the numerical treatment of boundary integral equations of the first and second kind. The methods combine relaxation schemes and coarse grid corrections. The choice of the relaxation scheme is found to be essential to attain a fast convergent iterative process. Theoretical investigations show that the relaxation scheme provides a multigrid algorithm whose rate of convergence increases with the dimension of the finest grid. This is illustrated for the calculation of potential flow around an airfoil. Author (ESA)

N84-20289# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

ADAPTIVE GRID GENERATION FOR NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS M.S. Thesis

K. G. BROWN Dec. 1983 77 p

(AD-A136985; AFIT/GAE/AA/83D-3) Avail: NTIS HC A05/MF A01 CSCL 12A

A new approach for the generation of flow-adaptive grids for numerical solution of fluid dynamics problems is presented. However, the method is applicable to the numerical evaluation of any partial differential equation. The dynamic coupling of the grid with the flow solution is accomplished through a grid-optimization technique. The optimization is based on the minimization of the finite difference truncation error in the transformed plane. The method is tested on the one dimensional Burgers' equation which is representative of typical fluid dynamics problems. Burgers' equation is solved with an optimized SOR (Successive Over Relaxation) method using upwind difference for the convective term. Results are presented for various Reynolds numbers and are compared to results from a similar adaptive grid method and to results for a static grid. They show the ability of the method to concentrate grid points high in gradient regions where large truncation errors occur. Author (GRA)

N84-20306*# Arkansas Univ., Fayetteville.

A METHOD FOR DETERMINING IF UNEQUAL SHAPE PARAMETERS ARE NECESSARY IN A BIVARIATE GAMMA DISTRIBUTION Final Report

J. D. TUBBS *In its* Statist. Modeling of Space Shuttle Environ. Data 13-34 23 Oct. 1983 refs

Avail: NTIS HC A07/MF A01 CSCL 12A

A procedure to aid in the deciding between four and five parameters in a Jensen's type bivariate gamma distribution is presented. It is based upon the CDF of the ratio of correlated

gamma distributed variates. The criteria are posed in a test of hypothesis setting and results are presented. E.A.K.

N84-20308*# Arkansas Univ., Fayetteville.
ANALYSIS OF WIND GUST DATA Final Report
J. D. TUBBS *In its* Statist. Modeling of Space Shuttle Environ. Data p 62-145 23 Oct. 1983 *refs*
Avail: NTIS HC A07/MF A01 CSCL 12A
Wind gust data were analyzed by statistical and mathematical procedures, developed for the bivariate gamma distribution. The results of the analysis are summarized. E.A.K.

N84-20312# Arizona State Univ., Tempe. Dept. of Computer Science.
APPROACHES TO AUTOMATIC STRATEGY ANALYSIS AND SYNTHESIS Final Report, 1 Sep. 1982 - 31 Aug. 1983 on Phase 2
N. V. FINDLER 1 Sep. 1983 10 p
(Contract AF-AFOSR-0340-82; AF PROJ. 2304)
(AD-A137067; AFOSR-83-1346TR) Avail: NTIS HC A02/MF A01 CSCL 12A
The efforts of the Group for Computer Studies of Strategies centered on five long-term projects: (1) The Generalized Production Rules System (GPRS) is a program which can support decision-making for a variety of expert systems in need of estimates of hidden variables. Hidden variables are such that their values can be identified only at certain times, either intermittently or periodically. In contrast, open variables are readily measureable at any time. The estimation is based on stochastic, causal relations between hidden and open variables. (2) The Quasi-Optimizer System (QO) is a program which observes and measures adversaries' behavior in confrontations, infers their strategies, and constructs a descriptive theory, i.e., a model, of each. It then identifies the components of the strategies, evaluates their effectiveness and combines the most satisfactory ones into a normative theory which is an optimum strategy in the statistical sense. (3) The advice Taker/Inquirer (AT/I) is a program which can be taught strategies by a human Advisor. The Advisor provides principles and high-level examples of actions in different situations. The system applies the strategy to test, verify and optimize the strategy. (4) The Interactive Environment for Planning and Decision Making uses two graphics screens, one displaying features of the current world, the other those of an extrapolated world with the estimated consequences of tentative decisions. (5) The Integrated System of Strategy Analysis and Synthesis for Air Traffic Control will be useful in teaching and evaluating Air Traffic Control Trainees. Author (GRA)

N84-20313# Naval Postgraduate School, Monterey, Calif.
DESCRIPTION AND ANALYSIS OF PACAM 5 (PILOTED AIR COMBAT ANALYSIS MODEL) AS A TACTICAL DECISION AID WITH A USER'S GUIDE FOR OPERATION AT NPS M.S. Thesis
D. M. KELLY Sep. 1983 78 p
(AD-A136793) Avail: NTIS HC A05/MF A01 CSCL 15G
The increasing cost of a thorough flight test of new fighter air-to-air tactics and equipment has made the use of simulation computer models to assist in this process desirable. This study presents an analysis and description of PACAM 5 (Piloted Air Combat Analysis Model). PACAM 5 is a computer model developed to assist in the evaluation of aircraft, armament, and tactics by simulating the performance of aircraft and weapons in combat. The PACAM damage models for the computation of aircraft probability of kill are analyzed and suggestions for improvement are made. An interactive User's Manual for operation of the model on the IBM-3033 computer at the Naval Postgraduate School is presented. Author (GRA)

N84-20314# Naval Postgraduate School, Monterey, Calif.
NEAR-OPTIMAL FINITE SOLUTIONS TO THE 3 AND 4 STEP DISCRETE EVASION GAMES M.S. Thesis
S. W. GOODSON Sep. 1983 50 p
(AD-A136811; AD-E301284) Avail: NTIS HC A03/MF A01 CSCL 12A
A review of discrete pursuer-evader games and known solutions is presented. A method is given for obtaining a finite memory, near-optimal evader strategy for the three-step game, which greatly reduces data storage requirements from previous near-optimal strategies. Additionally near-optimal evader strategies for the four-step game are discussed. Author (GRA)

16

PHYSICS

Includes physics (general); acoustics; atomic and molecular physics; nuclear and high-energy physics; optics; plasma physics; solid-state physics; and thermodynamics and statistical physics.

A84-23355*# Houston Univ., Tex.
JET NOISE MODIFICATION BY THE 'WHISTLER NOZZLE'
M. A. Z. HASAN, O. ISLAM, and A. K. M. F. HUSSAIN (Houston, University, Houston, TX) AIAA Journal (ISSN 0001-1452), vol. 22, March 1984, p. 340-347. refs
(Contract NSF MEA-81-11676; NAG3-198)
The farfield noise characteristics of a subsonic whistler nozzle jet are measured as a function of Mach number (0.25, 0.37, and, 0.51), emission angle, and excitation mode. It is shown that a whistler nozzle has greater total and broadband acoustic power than an excited contraction nozzle; and that the intensity of far-field noise is a function of emission angle, Mach number, and whistler excitation stage. The whistler nozzle excitation produces broadband noise amplification with constant spectral shape; the broadband noise amplification (without associated whistler tones and harmonics) increases omnidirectionally with emission angle at all Mach numbers; and the broadband amplification factor decreases as Mach number and emission angle increase. Finally the whistler nozzle is described as a very efficient but inexpensive siren with applications in not only jet excitation but also acoustics. C.M.

A84-24570
COMMENT ON 'NOISE TRANSMISSION INTO SEMICYLINDRICAL ENCLOSURES THROUGH DISCRETELY STIFFENED CURVED PANELS'
M. PETYT (*Southampton, University, Southampton, England*) Journal of Sound and Vibration (ISSN 0022-460X), vol. 92, Feb. 22, 1984, p. 599, 600; Authors' Reply, p. 600. refs

A84-25816#
BROADBAND NOISE OF TURBOFAN COMPRESSORS - POTENTIAL ROLE OF INERTIAL WAVES DUE TO ROTATING FLOWS [BRUIT ALARGE BANDE DES COMPRESSEURS ADOUBLE FLUX - ROLE EVENTUEL DES ONDES INERTIELLES LIEES AUX ECOULEMENTS TOURNANTS]
M. ROGER Lyon, *Ecole Centrale, Docteur-Ingenieur Thesis*, 1983, 102 p. In French. refs
Anomalous broadband peaks in the noise spectrum of a turbofan compressor are investigated theoretically, analyzing experimental data supplied by the Service Acoustique of SNECMA. The mechanisms and classical theories of noise generation in turbocompressors are reviewed; the anomalous peaks of the experimental data are characterized and compared to similar phenomena in the literature; and the role of inertial waves arising from rotating axisymmetric flow in the secondary channels as a possible source of the anomalous peaks is evaluated using a modal approach. A dispersion equation is developed for both acoustic and inertial modes, and the need for further analysis and numerical treatment in order to apply the findings to the actual

SNECMA compressor is indicated. Graphs and diagrams of the data and results are included. T.K.

A84-25863* Missouri Univ., Rolla.
A WAVE ENVELOPE FINITE ELEMENT SCHEME FOR ACOUSTICAL RADIATION
R. J. ASTLEY (Missouri-Rolla, University, Rolla, MO) IN: Finite element flow analysis; Proceedings of the Fourth International Symposium on Finite Element Methods in Flow Problems, Tokyo, Japan, July 26-29, 1982 . Tokyo/Amsterdam, University of Tokyo Press/North-Holland Publishing Co., 1982, p. 443-450. refs
(Contract NAG1-198)

The aeroacoustic problem associated with the radiation of fan noise from the inlet of a turbofan aircraft engine, the dimensions of which are generally many times larger than the acoustical wavelengths of the major energy-carrying frequencies, is considered. In the present approach, a conventional finite element solution in the inner region is compatibly matched to a 'wave envelope' finite element solution in a large but finite outer region. The inclusion of a wavelike variation with the correct asymptotic decay in the shape functions for the outer region preserves the correct behavior of the solution at large distances. The method is initially presented for a simple one-dimensional model based on the solution of Webster's horn equation. Results are presented for the specific case of a uniform cylindrical section joined to a conical expansion, and also for a simple axisymmetric test case of the calculation of acoustical pressure generated by a vibrating circular piston located at the center of an infinite rigid baffle. J.N.

N84-19049*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SIMPLIFIED COMBUSTION NOISE THEORY YIELDING A PREDICTION OF FLUCTUATING PRESSURE LEVEL
R. G. HUFF Feb. 1984 17 p refs
(NASA-TP-2237; E-1856; NAS 1.60:2237) Avail: NTIS HC A02/MF A01 CSCL 20A

The first order equations for the conservation of mass and momentum in differential form are combined for an ideal gas to yield a single second order partial differential equation in one dimension and time. Small perturbation analysis is applied. A Fourier transformation is performed that results in a second order, constant coefficient, nonhomogeneous equation. The driving function is taken to be the source of combustion noise. A simplified model describing the energy addition via the combustion process gives the required source information for substitution in the driving function. This enables the particular integral solution of the nonhomogeneous equation to be found. This solution multiplied by the acoustic pressure efficiency predicts the acoustic pressure spectrum measured in turbine engine combustors. The prediction was compared with the overall sound pressure levels measured in a CF6-50 turbofan engine combustor and found to be in excellent agreement. Author

N84-19050*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
HELICOPTER IMPULSIVE NOISE: THEORETICAL AND EXPERIMENTAL STATUS
F. H. SCHMITZ and Y. H. YU Nov. 1983 105 p refs Prepared in cooperation with Army Research and Technology Labs., Moffett Field, Calif.
(NASA-TM-84390; A-9477; NAS 1.15:84390; USAAVRADCOM-TR-83-A-2) Avail: NTIS HC A06/MF A01 CSCL 20A

The theoretical and experimental status of helicopter impulsive noise is reviewed. The two major source mechanisms of helicopter impulsive noise are addressed: high-speed impulsive noise and blade-vortex interaction impulsive noise. A thorough physical explanation of both generating mechanism is presented together with model and full-scale measurements of the phenomena. Current theoretical prediction methods are compared with experimental findings of isolated rotor tests. The noise generating mechanism of high speed impulsive noise are fairly well understood - theory and experiment compare nicely over Mach number ranges typical of today's helicopters. For the case of blade-vortex interaction noise, understanding of noise generating mechanisms and theoretical comparison with experiment are less satisfactory. Several methods for improving theory-experiment are suggested. Author

N84-19051*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AIRCRAFT AND BACKGROUND NOISE ANNOYANCE EFFECTS
K. F. WILLSHIRE Jan. 1984 31 p refs Presented at Human Factors Soc. Ann. Meeting, Norfolk, Va. 10-14 Oct. 1983
(NASA-TM-85744; NAS 1.15:85744) Avail: NTIS HC A03/MF A01 CSCL 20A

To investigate annoyance of multiple noise sources, two experiments were conducted. The first experiment, which used 48 subjects, was designed to establish annoyance-noise level functions for three community noise sources presented individually: jet aircraft flyovers, air conditioner, and traffic. The second experiment, which used 216 subjects, investigated the effects of background noise on aircraft annoyance as a function of noise level and spectrum shape; and the differences between overall, aircraft, and background noise annoyance. In both experiments, rated annoyance was the dependent measure. Results indicate that the slope of the linear relationship between annoyance and noise level for traffic is significantly different from that of flyover and air conditioner noise and that further research was justified to determine the influence of the two background noises on overall, aircraft, and background noise annoyance (e.g., experiment two). In experiment two, total noise exposure, signal-to-noise ratio, and background source type were found to have effects on all three types of annoyance. Thus, both signal-to-noise ratio, and the background source must be considered when trying to determine community response to combined noise sources. A.R.H.

N84-19052*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
NOISE-REDUCTION MEASUREMENTS OF STIFFENED AND UNSTIFFENED CYLINDRICAL MODELS OF AN AIRPLANE FUSELAGE
C. M. WILLIS and W. H. MAYES Feb. 1984 28 p refs
(NASA-TM-85716; L-15699; NAS 1.15:85716) Avail: NTIS HC A03/MF A01 CSCL 20A

Noise-reduction measurements are presented for a stiffened and an unstiffened model of an airplane fuselage. The cylindrical models were tested in a reverberant-field noise environment over a frequency range from 20 Hz to 6 kHz. An unstiffened metal fuselage provided more noise reduction than a fuselage having the same sidewall weight divided between skin and stiffening stringers and ring frames. The addition of acoustic insulation to the models tended to smooth out the interior-noise spectrum by reducing or masking the noise associated with the structural response at some of the resonant frequencies. Author

N84-19053# National Aerospace Lab., Tokyo (Japan).
SUPPRESSION OF PEAK NOISE BY RESHAPING COAXIAL FLOW CIRCUMFERENTIALLY UNDER STATIC CONDITIONS
K. TAKEDA and H. NISHIWAKI 1982 15 p refs In JAPANESE; ENGLISH summary
(NAL-TR-770; ISSN-0389-4010) Avail: NTIS HC A02/MF A01

The combination of a circular fan/elliptic core nozzle was tested and compared with the results of a conventional circular core/circular fan nozzle under static flow conditions. The results show that there occurred a change of the directiveness of jet noise around the nozzle when using the circular/elliptic nozzle combination. In a 30 to approximately 50 degree direction from the jet axis, a 3 to approximately 5 dB reduction was observed. Radial velocity distribution was measured by using LDV and axial sound source distribution by the polar correlation method in an anechoic room. Based on these measurements the relation between sound pressure generation and velocity distribution around the exhaust nozzle was discussed. A circular/elliptic nozzle

combination for turbo-fan engine exhaust nozzle combination for turbo-fan engine exhaust nozzle was recommended. Author.

N84-19058# Aeronautical Research Inst. of Sweden, Stockholm. Aerodynamics Dept.
THE EFFECT ON ACOUSTIC RADIATION OF MUTUAL INTERACTION BETWEEN A LINE VORTEX AND AN AIRFOIL M.S. Thesis - MIT, Cambridge
I. LINDBLAD Oct. 1983 57 p refs
(Contract STU-81-4626B)
(FFA-TN-1983-45) Avail: NTIS HC A04/MF A01

A two dimensional model for the interaction, at high (subsonic) Mach numbers between a line vortex and the leading edge of a semi-infinite airfoil is developed. For a small vortex strength the flow region is shown to be noncompact. An approximate vortex path past the leading edge is calculated, assuming the vortex strength to be small but finite, using the Wiener-Hopf technique. The acoustic radiation is shown to be due, to lowest order, to unsteady loading on the airfoil, and vortex acceleration. Vortex acceleration is shown to give a small contribution to the total sound radiation for moderate Mach numbers. For Mach numbers close to unity, this effect is shown to give a significant contribution to the sound radiated upstream in the plane of the airfoil. Author (ESA)

N84-19071# Electronics Engineering Group (1842nd), Scott AFB, Ill.
FEASIBILITY OF REMOTING BRITE 2 VIA FIBER OPTICS
30 Sep. 1983 8 p
(AD-A135858; REPT-1842-EEG-TR-83-18-EX) Avail: NTIS HC A02/MF A01 CSCL 20F

This report is in response to tasking from EIC/EIW to determine the feasibility and method by which the BRITE 2 system could be remoted using fiber optics (FO). Research of the system technical order and measurements of the signal characteristics show the use of FO remoting is feasible. This report provides a recommended configuration for a FO remoting system. Author (GRA)

N84-20320*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LOW FREQUENCY NOISE IN A QUIET, CLEAN, GENERAL AVIATION TURBOFAN ENGINE
R. G. HUFF, D. E. GROESBECK, and J. H. GOODYKOONTZ Jan. 1984 55 p refs
(NASA-TM-83520; E-1879; NAS 1.15:83520) Avail: NTIS HC A04/MF A01 CSCL 20A

A quiet, clean, general aviation, turbofan engine was instrumented to measure the fluctuating pressures in the combustor, turbine exit duct, engine nozzle and the far field. Both a separate flow nozzle and an internal mixer nozzle were tested. The fluctuating pressure data are presented in overall pressure and power levels and in spectral plots. The combustor data are compared to recent theory and found to be in excellent agreement. The results indicate that microphone correction procedures for elevated mean pressures are questionable. Ordinary coherence function analysis suggests the presence of an additional low frequency noise source downstream of the turbine that is due to the turbine itself. Low frequency narrowband data and coherence function analysis are presented. Author

17

SOCIAL SCIENCES

Includes social sciences (general); administration and management; documentation and information science; economics and cost analysis; law and political science; and urban technology and transportation.

A84-24961
REGULATIONS AND THE AIR AMBULANCE
H. L. GIBBONS Aviation, Space, and Environmental Medicine (ISSN 0095-0562), vol. 55, March 1984, p. 239-243. refs

The recent biopolitical history of air ambulance development and the need for regulations is reviewed. There has been significant interaction between Aerospace Medical Association comittees, the Federal Aviation Administration, and the Civil Aeronautics Board. The Federal Aviation Administration's Advanced Notice and Withdrawal of Proposed Rulemaking, the latter based on the FAA supposition that the 'majority' of states had enacted regulatins and guidelines, is compared to actual data that only seven states have regulations and two have guidelines. The precedence for FAA to act on regulations is established. The Aerospace Medication Association and the National Highway Traffic Safety Administration - not the FAA have established and documented excellent guidelines. The FAA is providing a valuable service to aviation in general and air ambulance operations specifically through physiological training at military facilities which can provide information to promote patient protection in air ambulance operations. Author

A84-25032
AIRWORTHINESS DIRECTIVES - RECOVERING THE COST OF COMPLIANCE
D. WILSON (Grant, McHendrie, Haines, and Crouse, Denver, CO) Journal of Air Law and Commerce (ISSN 0021-8642), vol. 49, Fall 1983, p. 1-30. refs

The legal status of liability questions arising when FAA Airworthiness Directives (AD) mandate modifications to an aircraft is reviewed. Aircraft owners often attempt to recover from the manufacturer the costs of compliance to an AD, claiming either breach of warranty, negligence, strict product liability, or a private cause (implied) under the Federal Aviation Act of 1958. A survey of the case law in each of these areas reveals that owners have only very limited prospects of recovering compliance costs. A negotiated solution to this problem in the form of specific, strong AD-compliance warranties is considered more desirable than a legislative requirement that manufacturers bear all compliance costs. T.K.

N84-19133* National Aeronautics and Space Administration, Washington, D. C.
SIGNIFICANT NASA INVENTIONS AVAILABLE FOR LICENSING IN FOREIGN COUNTRIES
1978 114 p
(NASA-SP-7038(05); NAS 1.21:7038(05)) Avail: HC SOD CSCL 05B

Aeronautics; space flight and satellites; chemistry, and polymers and materials; electrical, electronics, and computers; fluid mechanics and heat transfer; instrumentation; solar energy; medical and life sciences; photography and optics; mechanical engineering, testing, and metal forming; and lasers and masers are covered. N.W.

N84-19134* National Aeronautics and Space Administration, Washington, D. C.
SIGNIFICANT NASA INVENTIONS AVAILABLE FOR LICENSING IN FOREIGN COUNTRIES
1984 156 p
(NASA-1984-SP-7038(07); NAS 1.21:7038(07)) Avail: HC SOD $4.75 as 033-000-008-96-1 CSCL 05B

Aeronautics; space flight and satellites; chemistry, polymers, and materials; electrical, electronics and computers; fluid mechanics and heat transfer; instrumentation; solar energy; medical and life sciences; photography and optics; mechanical engineering, testing, and metal forming; and lasers and masers are covered. N.W.

N84-19136*# National Aeronautics and Space Administration, Washington, D. C.
AEROSPACE BIBLIOGRAPHY, SEVENTH EDITION
J. F. BLASHFIELD, comp. 1983 140 p
(NASA-TM-85438; NAS 1.15:85438) Avail: NTIS MF A01; HC SOD CSCL 05B

Space travel, planetary probes, applications satellites, manned spaceflight, the impacts of space exploration, future space activities, astronomy, exobiology, aeronautics, energy, space and the humanities, and aerospace education are covered. N.W.

N84-19137*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SCIENTIFIC AND TECHNICAL INFORMATION OUTPUT OF THE LANGLEY RESEARCH CENTER
Jan. 1984 236 p refs
(NASA-TM-85735; NAS 1.15:85735) Avail: NTIS HC A11/MF A01 CSCL 05B

Scientific and technical information that the Langley Research Center produced during the calendar year 1983 is compiled. Included are citations for Formal Reports, Quick-Release Technical Memorandums, Contractor Reports, Journal Articles and other Publications, Meeting Presentations, Technical Talks, Computer Programs, Tech Briefs, and Patents. Author

N84-19183# Civil Aeronautics Board, Washington, D.C.
ECONOMIC CASES OF THE CIVIL AERONAUTICS BOARD, VOLUME 101, APRIL 1983 TO MAY 1983
1983 934 p
(PB84-127695) Avail: NTIS HC A99/MF A01 CSCL 05C

Fitness investigations, services, and employee protection programs are considered. The argument presented by the contesting parties and the case rulings are included. GRA

N84-19184# Civil Aeronautics Board, Washington, D.C.
ECONOMIC CASES OF THE CIVIL AERONAUTICS BOARD, VOLUME 102, JUNE 1983 TO JULY 1983
1983 870 p refs
(PB84-127703) Avail: NTIS HC A99/MF A01 CSCL 05C

Fitness investigations, route transfers, and service proceedings are described. The arguments presented by the contesting parties and the case rulings are included. GRA

N84-19868# Shock and Vibration Information Center (Defense), Washington, D. C.
TECHNICAL INFORMATION SUPPORT FOR SURVIVABILITY
H. C. PUSEY, R. H. VOLIN, and J. G. SHOWALTER *In its* The Shock and Vibration Bull., Part 1 21-31 May 1983
Avail: SVIC, Code 5804, Naval Research Lab., Washington, D.C. 20375 CSCL 05A

DoD policy requires that system survivability be a major consideration in the systems acquisition process. The need for an effective DoD survivability/vulnerability information service is established. The technology sources and the user community are examined and options are discussed for the organization of the information service. Recommendations are offered on the steps to take for the establishment of such a service. Author

N84-20444# Naval Postgraduate School, Monterey, Calif.
STATISTICAL MODELS FOR ESTIMATING OVERHEAD COSTS
D. C. BOGER Oct. 1983 45 p
(Contract F60-433)
(AD-A137351; NPS54-83-014) Avail: NTIS HC A03/MF A01 CSCL 12A

Five years of quarterly overhead costs at two major defense aircraft manufacturers were categorized according to the types of costs incurred. These categories of overhead costs were then modeled via regression analysis using production and operating data from the two contractors as independent variables. Adjustment for quarterly autocorrelation revealed excellent structural and predictive models of total overhead and labor-related overhead costs. Author (GRA)

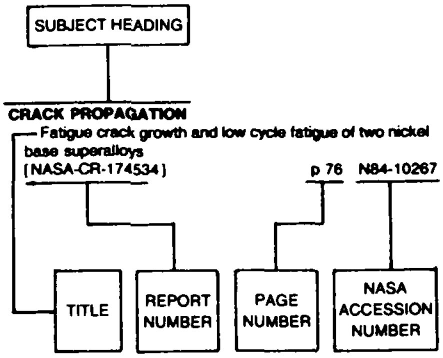
19

GENERAL

N84-20471# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio. Flight Dynamics Lab.
AIR FORCE TECHNICAL OBJECTIVE DOCUMENT FISCAL YEAR 1985
Oct. 1983 61 p Supersedes AFWAL-TR-82-3000
(Contract AF PROJ. 9991)
(AD-A136724; AFWAL-TR-83-3000; AFWAL-TR-82-3000) Avail: NTIS HC A04/MF A01 CSCL 01C

The document presents an overview of the five laboratory thrusts extracted from the FY 85 Research and Technology Plan of the Flight Dynamics Laboratory. Technical objectives are described for the thrusts of Night In-Weather; Supersonic Persistence; Sortie Generation; Space (and Missile) Applications; and Multimission Core Technology. GRA

Typical Subject Index Listing



The subject heading is a key to the subject content of the document. The title is used to provide a description of the subject matter. When the title is insufficiently descriptive of the document content, the title extension is added, separated from the title by three hyphens. The (NASA or AIAA) accession number and the page number are included in each entry to assist the user in locating the abstract in the abstract section. If applicable, a report number is also included as an aid in identifying the document. Under any one subject heading, the accession numbers are arranged in sequence with the AIAA accession numbers appearing first.

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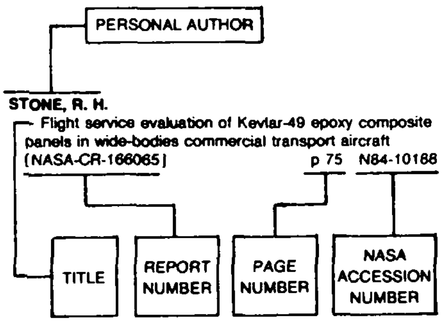
PERSONAL AUTHOR INDEX

Typical Personal Author Index Listing



Listings in this index are arranged alphabetically by personal author. The title of the document provides the user with a brief description of the subject matter. The report number helps to indicate the type of document listed (e.g., NASA report, translation, NASA contractor report). The page and accession numbers are located beneath and to the right of the title. Under any one author's name the accession numbers are arranged in sequence with the AIAA *accession numbers appearing first.*

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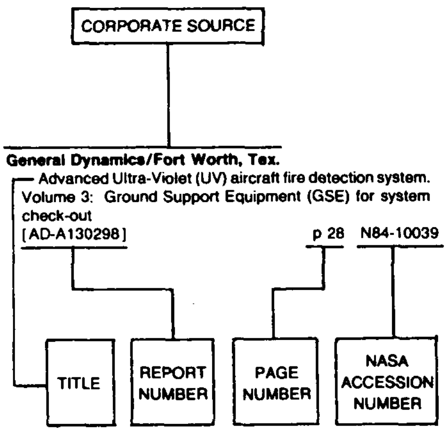
Typical Corporate Source Index Listing



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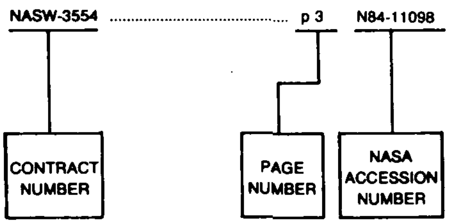
Typical Contract Number Index Listing



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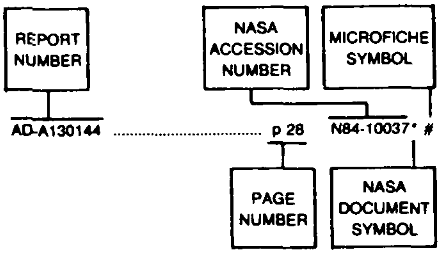
Typical Report Number Index Listing



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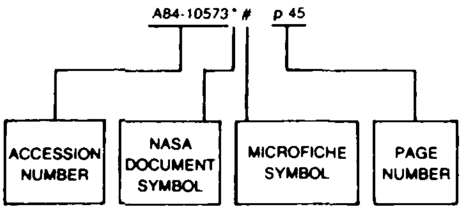

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